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THE STREET RAILWAY CONVENTION.

The sixteenth annual convention of the American Street Railway Association, which has just closed its session at Niagara Falls, was one of the most successful in the history of that organization. The attendance was unusually large, the exhibits were numerous and excellent, and the papers of a high standard. The only disturbing element was the dreary weather, but even this could not dampen the enthusiasm of the delegates or mar their enjoyment of the interesting occasion.

The deep interest displayed by these practical electric railway men in the future of electricity as a traction agency on railways now operated by steam was a marked feature of the gathering. The several exhibits of motors and trucks adapted to high speed and heavy service showed that manufacturers are also beginning to prepare for the coming transformation of railroad operation.

The storage battery came in for a large share of attention. This admirably efficient adjunct to the street railway has not received in America the same careful consideration that European engineers have given to it. The discussion of methods for its use betrayed the deep interest which is beginning to be felt in the matter by practical operators of railroads, and some suggestions that were advanced were both novel and valuable.

The exhibits were excellent and very interesting, several novelties being shown. The citizens of Niagara Falls exerted themselves in hospitable efforts for the entertainment of the visitors and added greatly to the pleasure of those attending the convention, especiallly the ladies. The great success of this meeting shows that the association is in a vigorous state of activity, and promises much for its future usefulness.

ELECTRIC POWER ON PRIVATE RIGHTS OF WAY.

The remarkable inroads of the trolley systems on the short-haul passenger traffic of the steam railroads has hitherto stirred up no vigorous action on the part of the latter to hold their business. They have, as a rule, simply given up the struggle and taken off or reduced their train service, arguing that the electric road had a free right of way and could distribute its network to every one's doorstep, and that there was no use in struggling against such odds.

Col. N. H. Heft, in his paper on "The Application of Electricity to Railroads Now Operated by Steam Power," has shown how one railroad by adopting the motive power of its rival has regained a large amount of its traffic. The steam railroad has advantages to compensate for those of the street railroad. Chief of these is the private right of way, allowing speeds far above those allowable in a public street or highway. By adopting electric power the steam road can give its passengers the frequent service and the comfort found on the street railway. In addition, it can give much greater speed. The New York, New Haven and Hartford Railroad Company has settled the question of local passenger distribution by giving transfers to the street car lines. The only disadvantage of such a method is the change of cars necessitated. Street-railway cars are gradually being made larger, heavier and better equipped until there is now no reason why the same cars should not be run

at high speeds over private rights of way between cities and over the street-car tracks at ordinary speeds in the business centres. Such a through service would be almost ideal, as it would combine speed with convenient passenger distribution without change of cars. Steam roads with short interurban service will probably soon find it necessary to combine with the local street railway lines in this way to prevent their building on private rights of way and getting all the business.

It has long been recognized that the adoption of electric traction on streets increased the traffic greatly, but its effect on steam roads seems to be even more marked. Colonel Heft cites a 200 per cent. increase on the Nantasket line and a 400 per cent. increase in one year on the Berlin-Hartford line. Such figures are worth considerable study on the part of railroad financiers.

MUNICIPAL OWNERSHIP OF STREET RAILWAYS.

The perennial subject of municipal ownership of quasi-public industries was brought before the meeting of the American Street Railway Association at Niagara Falls this week in a paper by Mr. P. F Sullivan, a brief abstract of which is printed on another page in this issue.

Mr. Sullivan asserts that the powers and duties of municipalities should be abridged rather than enlarged, for the reason that the administration of municipal affairs in American cities is unbusiness-like and extravagant. This arraignment, however, is rather sweeping and general, and does not admit of giving credit where credit is due. It is true that in many, if not in all, the larger cities this state of affairs does presumably exist, but, on the other hand, there are many others—smaller places usually— where public affairs are administrated for the best interests of their citizens, economically and after proper business methods. Mr. Sullivan's argument, however, is not altogether one relating to municipal administration, but rather against the principle of municipal ownership of street railways, and what applies to railways necessarily applies to the electric-lighting business.

If the affairs of all cities were administered for the good of the citizens and not for the benefit of a few favored ones first and the people second, there might be some grounds for admitting the practicability of municipal control and administration of the enterprises in question. Until municipal politics have become purified, however, and the principle of self-government of cities is carried out to the letter, the public interests can be best served in the operation of street railways and electric lighting by private enterprise.

RAIL JOINTS AND DEPRECIATION.

One of the worst troubles experienced in the operation of street-railway systems since the adoption of mechanical traction is the pounding over rail joints. The slightest inaccuracy in the leveling of a rail joint either when first put in place or developed later by frost, rapidly grows worse. The continual pounding of the wheels of heavily loaded car trucks over the joints wears a "flat" on the lower rail end and also tends to bend the whole rail and thereby cause the end of the rail to be further depressed. Street-car rails have been continually made heavier and heavier and all sorts of tie plates, welded joints, cast joints, etc., have been developed to remedy this difficulty, but as yet no satisfactory solution of the problem seems to have been found. In the city of Dresden the street railway company has taken the "bull by the horns" and planed the joints true. A simple and crude but effective hand-planing tool used for this purpose is described in another column. Probably the first idea that will arise in the mind of any American engineer on reading the description of this device is "Why don't they use a motor driven milling cutter?"

It might seem at first sight as though this planing process would soon form a hollow at the rail joints which would be as undesirable as the bump which is thus removed. However, as an occasional milling when the difference of level is slight would prevent the cumulative action of the pounding effect, the process would not need to be applied very frequently. The wear and tear of trucks, motors and other running gear due to bad joints is so serious that any method of eliminating it is well worth considerable trouble and expense.

MULTIPHASE DISTRIBUTION FOR STREET RAILWAYS.

The rotary converter in which alternating current is directly transformed to direct current in the same coils has many peculiarities which are not understood. Like the alternating synchronous motor, it will remain in synchronism with the source of supply, in spite of all sorts of circumstances which would apparently disturb it. Like the direct-current dynamotor it has no field distortion and no mechanical torque on the rotating parts, but, unlike the dynamotor, its transforming capacity is much greater than its generating capacity.

Mr. Maurice Hoopes, in his paper on "Power Distribution and the Use of Multiphase Current Transmission for Ordinary Street Railways," has brought up as a disadvantage the liability of the rotary transformer to slow down on short circuit, and the time required, "15 to 20 minutes," to get it into operation again. Remembering that a load has no tendency to change the speed of a rotary transformer, in case of heavy overloads the rotary transformer would keep running until the line was severed at some other point. If the alternating-current side were opened the machine would stop, but there is no reason why it should take any longer time to start it again than to start a motor of the same size, perhaps one-half a minute. Rotary converters are made now self-starting on either the alternating or direct current side.

Mr. Hoopes states also that in case of a low load factor it is cheaper to work with the simple direct-current system, necessitating excessive losses in the copper at times of heavy loads, than to maintain the alternating-transmission apparatus. While this may seem to be true at first, its fallacy is apparent in the case, for example, which Mr. Hoopes cites, where the voltage is raised by boosting 100 per cent. to tide over a heavy load, all of which is lost in the feeders. As this requires central-station machinery capable of generating double the energy used on the line, while the alternating-transmission system would require the generation of perhaps 25 per cent. more than that used, it would seem as if the expense of maintenance would be more serious with the direct than with the alternating.

Electric Power Transmission on a Graving Dock.

The Spanish Government has been compelled by the war in Cuba to provide a dry dock for its war ships on this side of the water. The dock is of the floating type, and has been built in England. The power for emptying the pontoons is transmitted from the engines to the pumps by electrical means. In each of the two side walls there is an electrical generating station, in which two Tyne dynamos are direct coupled to compound vertical engines. Ten electric motors are provided, five in each wall, with starting boxes located in the valve rooms. The motor shafts are vertical, running down to the centrifugal pumps, which revolve in a horizontal plane near the bottom of the pontoon. The pumps are capable of discharging six thousand tons of water per hour against the variable head which is dependent on the depth of immersion.

Power Distribution and the Use of Multiphase Current Transmission for Ordinary Street Railways.*

BY MAURICE HOOPES.

The subject that has been assigned to me for discussion is one that has received considerable attention of recent years. Aside from the demands of what is usually considered steam-railroad service, the business of the ordinary urban and suburban railways has grown lately in a way that requires some means of augmenting the usual method of power distribution. Lines have been extended to greater distances from power stations, and traffic has increased on lines which always have been remote from their points of power supply. These conditions have arisen at places where disadvantages of location or lack of sufficient load would render additional power stations unprofitable. To meet such demands several methods have been devised. The consideration of the comparative merits of these systems is the principal purpose of this paper. Before undertaking this task, however, the writer desires to discuss some of the conditions met with in the operation of the ordinary 550-volt distribution system. Some of the points raised have been frequently made. For these an apology is offered in advance, the excuse being that they are sufficiently important to bear reiteration.

The usual electric-railway distributing system, with its copper network as one, and its iron network as the other half, offers rather more complicated problems than does the ordinary form of all copper circuits. The latter system is symmetrical, whereas the former is likely to have greater resistance in the copper than in the iron portion. A rule that holds good of both systems is that *the maximum benefit in reduction of total resistance, due to the addition of a given amount of conductor, results when the addition is made to the parts in which the drop is greatest per unit of length.* An observance of this rule is important in adding to distribution systems. This demands a careful analysis of existing conditions. Before adding feed wire to a railway circuit, it is important to know the drops, under usual load, of the parts of the circuit. These may be found by the use of pressure wires, or by short-circuiting the trolley wire to the rail and passing a given current through the circuit, measuring the total drop, and deducting the calculated overhead resistance from the total resistance thus found. Private telephone lines serve the purpose of pressure wires to measure track drops and public lines, connected through the exchange, may be used without interference with the service. An exception to the general rule that the copper should be added to the part of the circuit showing the greatest resistance, is the case of a poorly-bonded track that may show less resistance than the overhead. Re-enforcing such track with overhead copper connected to each end of all special work may result in the greater decrease in the total resistance of the circuit. This is really a special application of the general rule, rather than an exception to it, however.

Means for regular and easy measurement of track joint drops should exist. For a track having frequent high-resistance joints, there is no better way than walking over it with a low-reading voltmeter connected to prongs on the end of a stick that may be bridged across joints. For detecting poor joints in good track, where they are far apart, and for the general inspection of the condition of track wiring, a car is convenient. A box trailer with each wheel insulated from all others, and a voltmeter connected between the two wheels on each side of the car, may be used. A third meter connecting the two opposite wheels will indicate defects in cross-bonding. The writer considers that it is unnecessary to complicate the measurements by attempting to measure the resistance of the joints. His experience is that if a bond is loose enough to have a normal resistance it will get worse rapidly, and show excessive drop with even small amounts of current. It behaves very much as did Longfellow's little girl, and is either "very, very good," or "horrid."

It is universally recognized that the maximum efficiency is obtained from a distribution system when it is operated as a whole and not divided into sections. The liability of accident to railway trolley wires makes it necessary to separate them in such a way that trouble at one point will not block the whole road. These sections should be as few as possible, while accomplishing the purpose for which they are designed.

Where one road has two or more power stations, the sections approximately equidistant from each of the two stations should be connected with both. They may then serve to equalize load between stations, the common section being cut loose from the station needing to decrease load. Two feeders to such a section—one from each station—constitute a tie line between stations. If desired, the potential may be raised in one station to a point that will deliver current into the other. Unless the drop in the combined feeders is excessive, it will probably be safe to allow the section attached to take the increased potential. Tie lines between stations, which serve none but emergency purposes, are expensive, especially if the stations are distant from each other.

Where the ordinary methods of distribution are not applicable because of the prohibitive amount of copper necessary, some one of the following systems is commonly used to care for the particular section:

1. A "special generator" run at increased voltage, and usually over compounded as much as possible, handling the section and no other load.

2. A "booster," consisting of a series-wound generator, connected in series with the feeder as it leaves the main station bus. The field turns of this generator should be such as to make the E. M. F. of the armature as nearly as is possible equal to the drop in the feeder, throughout all ranges of current.

3. The "three-wire system." This requires the division of the section into two. One-half is then supplied from the regular bus, and the other from a special generator, with the polarity reversed, to bring the trolley wire opposite in potential to that of the rest of the system. The trolley wire should be so divided into the two half sections as to leave, as nearly as possible, equal loads on the two at all times. With this arrangement the current in the track is only that flowing from the cars on one-half section to those on the other. If these half sections are located near each other, this path through the track is very short. For this reason it is usual to make one track of a double-track road one-half, and the other track the second half section. Unless conditions are such that the cars are likely to be bunched on one track, this seems the better way of dividing. In addition to conducting current between cars, the track has to conduct back to the power station the excess in current used on one-half section over that used on the other.

4. The alternating-current transmission system. The only form of alternating current system desirable for railroad work consists of high-voltage multiphase generators (or low-voltage generators with step-up transformers) in the main station, connected with one or more sub-stations containing step-down and rotary transformers. There are some half a dozen such systems in use in this country, of which the best known are those from Lowell to Nashua, and from the station of the Niagara Falls Power Company to Buffalo.

With any of the foregoing systems, the storage battery may be applied as an auxiliary. In a railway-power station a battery is useful to the extent that it improves the station capacity and fuel economy by removing the *immediate* fluctuations. The writer considers that there are few instances where a battery can be installed with resulting profit where its function is the storing of power one hour for use the next. Except with very short-time peaks, the battery costs as much as the additional generating apparatus. Particularly in small stations, however, there is such a variable load that it is impossible to average full load from the station for a period of time, because of the inability to handle the very great short-time overloads that such an average load demands. In such a station a battery may result in a considerable increase in station capacity, and, by allowing the engines to operate at practically constant loads, reduce the fuel consumption greatly. While a battery may do these things in the station, it may do even more remote from the station. In the latter location it will keep the potential near it practically constant, and will also maintain uniform current flow between the station and the particular point, thus adding the advantages of regulation and greatly increased copper efficiency.

One side of the story makes a pretty good case for the storage battery; unfortunately, the other must be told. The first cost of a battery is so very great that reasonable interest and depreciation

*A paper read at the Convention of the American Street Railway Association, Niagara Falls, 1897.

on the amount invested will more than consume the apparent saving in many cases. Especially is this so in the case of a battery located on the line, where it has been shown that the gross saving is the greatest. This is true, because it requires a very much larger investment in battery to care for the load variations of a given station if the batteries must be divided up among several sub-stations, the load factor of each of which is necessarily lower than that of the main station. The sum of the maximum variations of the several stations is always greatly in excess of the maximum variations in the main station. If, however, a power station were to be located at a considerable distance from a single centre of distribution, through which all feeders from the station passed, it is quite probable that a battery placed at the latter point would result in a net saving, due to its giving both the station and copper an uniform load.

When it becomes necessary to select from the foregoing list the most suitable system for a given case there are many conditions to consider in the decision. Either of the first three—the special generator, the booster, or the three-wire system—may be arranged with the apparatus in any railway power station, assuming that it includes a reserve generator of the necessary size. It is better to use standard railway machines for these purposes, and, if possible, to arrange the station so that any one of the regular station machines may be used. It frequently occurs that one or more sections of line fed from a certain station have copper enough leading to them to care for them properly at all times excepting a few

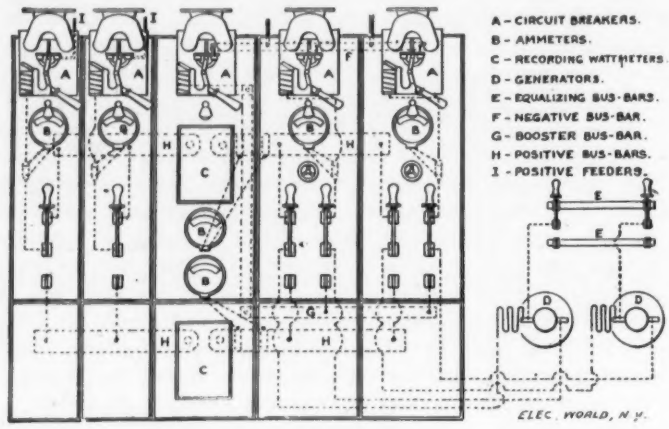


Fig. 1.

hours on each ordinary day, and for longer periods on heavy days. While the work may be quite variable at times of light load, when the load increases it becomes more nearly uniform. Such sections may be satisfactorily supplied over the copper designed for the lighter load, by raising the voltage on the station end of the feeder during heavy loads. Usually the margin in the field rheostat will allow the increase of voltage on any one of the generators to a point considerably above the normal. When this is not so it is possible that the generator speed may be increased, unless limited by the requirements of safety in the driving engine.

In one or both of these ways it is often possible to get from 700 to 750 volts from a standard 550-volt machine. This increase enables the heavy load on the section to be handled very satisfactorily. The voltage at the feeder end necessarily varies with the load, and with ordinary fluctuations there may easily be 100 volts difference between the minimum and maximum. A recording voltmeter placed at the feeder end will show a very inky piece of paper after a run. In practice, on a line which the writer finds it necessary to handle in this way, he gets variations from 450 to 550 volts. The minimum is infrequent, however, and the schedule is made apparently as well as though the potential were absolutely uniform.

Considering the question of abuse of apparatus, the increased voltage is not likely to injure a generator of modern construction. Practically the only additional care that seems necessary is of the generator fields, noting that the increased current in the shunt windings does not heat them above safe temperature. So long as the potential at the car stays under 600 volts there is little probability of trouble with equipment. Although the writer has had no such experience, he has known of cases where higher voltages have caused the arcs at controller contacts, when breaking, to jump to the iron frames. This difficulty has been experienced more particularly on small roads using boosters, where one car might constitute the entire load on the booster. At times of throwing off the power, the booster holds up its potential for a sufficient time to result in a very greatly increased voltage during the time of the controller opening.

The method just described has the advantage of simplicity and economy. Cases arise, however, when the very great fluctuations in load make its use impracticable. With a line which, at certain times, carries very heavy current, as compared with the average, there must be some means of automatically raising and lowering the voltage at the station end of the feeder to properly compensate for the variable drops. To accomplish this a booster is used. As has been said, this machine is a series-wound generator, connected in the feeder as it leaves the main bus, and so proportioned that a given current through it will give sufficient field strength to induce an E. M. F. in the armature equal to the fall of potential which the same current causes in the feeder. In practice this condition is only approximated. Were the generators to have a perfectly straight characteristic curve of proper pitch to match that of the feeder drop, the feeder end potential would eactly coincide with that of the power station. The curves of all dynamos droop away toward the horizontal as the magnets approach saturation. This results in the booster failing to compensate wholly for drops of current above a certain amount. In practice, however, boosters are used which raise a feeder potential to 1000 volts, and care for variable loads without allowing the light load voltages to rise to dangerous amounts at the feeder ends. The system has the advantage of caring for extreme overloads on particular feeders, and is useful in cases where, for short periods of time, the feeder load is such as to cause excessive drops and the time is not great enough to justify increased copper investment. On the other hand,

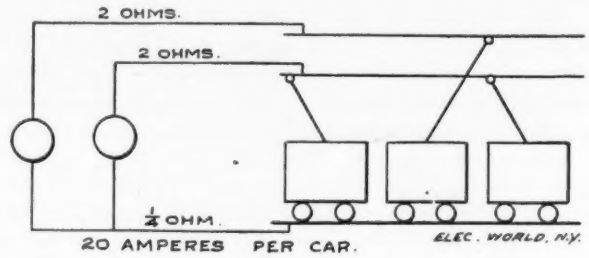


Fig. 2.

it is expensive of operation, due to the facts that it wastes considerable energy, and that it generates this wasted energy in rather an extravagant way. If the booster is engine-driven, the engine has widely fluctuated loads to handle, the load varying as the square of the current in the feeder. These variations necessarily result in a very low economy for the engine. With a motor-driven booster there are the constant losses of the two machines to meet. These are not so great as those of the engine and booster, but the necessity of keeping a particular generator for use as a booster limits the flexibility of the arrangement as compared with one which permits the use of any of the regular station generators, and, moreover, the addition of a motor booster does not increase the capacity of the station, as the power to drive the motor must come from the engines. The compounding of the standard types of railway generators is usually such that, when full-load current is passed through them, the series turns alone will raise the fields to a point that will induce nearly normal E. M. F. in the armature. This adapts the machine for use as a booster on almost any line, excepting one requiring more than 100 per cent. increase of potential at times of full load. As lines when so overloaded would be much better provided for by the addition of more copper, they need not be considered. In most cases it is necessary to *cut down* the E. M. F. of the standard generator in order to secure the proper ratio of E. M. F. to current for boosting, and this may be done by decreasing either its speed or the number of field turns. The former method has the advantage with an engine-driven unit of improving the engine economy by lessening the friction losses and keeping the cut-off at a less wasteful point, whereas the latter is the simpler way. To accomplish this, the writer uses a long German silver strip of sufficient section to carry the proportion of current that it is desired to shunt out of the fields. This strip is fas-

tened to the generator frame, connected across the terminals of the series field, and doubled on itself in such a way that a clamp may be slid back or forth on it, raising or lowering its resistance. Knowing the resistance of the feeder upon which the machine is boosting, the clamp may be shifted to the point where the ratio between the readings of the voltmeter and ammeter is equal to the feeder resistance, and the proper adjustment reached.

For temporary uses it is possible to make the necessary switchboard connections with flexible cables as the only adjuncts to the apparatus on the regulation board. A cable which may be attached to the positive lead of any of the generators, at the switchboard, and to any feeder, answers the entire purpose. With some boards it is only necessary to have terminals on the cable that may be inserted into switch jaws. If the generator leads and the feeders happen to terminate in switch blades instead of jaws, the cable must have its ends fitted to clamp quickly to these blades. With this preparation, in order to transfer a particular feeder to a special generator for the purpose of increasing the voltage upon it, the cable should be attached to the positive generator terminal, the other end hung convenient to the feeder switch, the generator built up already for use, the feeder opened and attached to the cable, and finally the circuit breaker and negative generator switch closed.

If it is desired to extend this system to booster working, it is necessary to have a second cable leading from the positive bus bar, and capable of connection to the negative terminal of the booster. It is best to include a circuit breaker in this cable to protect the booster, as the regular generator circuit breaker will be cut out.

At best, however, cables are troublesome appliances, and allow only comparatively slow transfers. Moreover, it is impracticable to arrange cables so that two generators may be run in parallel on the special high-voltage service. Where a new board is being installed, and where the circumstances justify the alterations in an existing board, such a one as is shown in Fig. 1 meets the required conditions. The two equalizing bars make it possible to run two or more machines on each the regular and high voltage at one time. With the arrangement any two combination of feeders and generators desired may be had. When running the "special generator" the negative switches are thrown up, and the positive and equalizing switches on the special machines thrown down. The switches on the feeders needing the increased voltage are likewise thrown down. If it is desired to use the auxiliary bus for booster purposes the equalizing switch is left open and the adjustable field shunt applied, the negative generator switch is thrown down, after closing the booster circuit breaker, and the feeder is transferred down to the auxiliary bus. This puts the booster generator in series with the particular feeder. One very important thing in this connection is to make sure that the shunt-field circuit is open on the booster generator. It might be advisable to interlock the field switch with the negative generator switch in such a way that the latter could not be thrown down except with the former open.

The drawing of the board shows a wattmeter and an ammeter in each bar. By providing a double-throw switch connected in such a way as to open the lower wattmeter from the feeder board, and connect it to the upper bus bar on the generator side of the ammeter shunt, the four instruments will be in series between the generators, all running on the lower bus, and the feeders all running on the upper bus. This offers convenient means for checking meters, care being taken to see that current passing through the diagonal bar, on the back of the instrument panel, does not introduce an error into the wattmeter indications.

In a modern station of few large units it is improbable, were the necessity for booster service to exist, that one of the large generators could be spared or would be desirable for the purpose.

In such stations, however, it is usual to install a smaller machine to carry the all-night and other light loads. This machine might be relied upon for the booster work. If the engine driving it has its governor arranged to adjust for a large variety of speeds, both above and below normal, and the unit be designed to run safely at the increased speeds, the combination will be found very convenient for meeting all classes of demand. The speed may be dropped for booster working, and raised when the generator is run at high voltage on a particular feeder. With this arrangement of dependence upon an individual unit for the special service, it is of course unnecessary to equip the whole switchboard with the extra negative bus. The double-positive bus will be found convenient in any station, however.

The three-wire system, although very useful in lighting work, has been of little service in railroad distribution. Its value for the latter purpose has been considerably overestimated, although there are places where its use has resulted in the maintenance of satisfactory potential on sections of track, using the same copper, when the usual system could not approach doing it.

The advantage of the three-wire system is based on the fact that it enables the use of double the usual potential for distribution, thus in the perfect case requiring but one-fourth the copper to transmit a given current at a given loss.

This law, that the amount of copper varies inversely as the square of the potential, is due to the fact that doubling the voltage halves the current for a given amount of energy. The same percentage of loss allows a loss of twice the number of volts, and this, with but half the current, admits of the use of copper having four times the resistance, hence one-fourth the weight. The "perfect case" just cited is one in which no third or "neutral" wire is necessary. Such a one does not exist in practice, and this neutral wire has to be supplied to conduct the excess of the current used on one side of the system over that used on the other, between the generators and the motors. In railroad work the rail is used as the neutral conductor. It is seldom that a whole road is operated on the system, the common practice being to apply it to only those parts on which the ordinary system is insufficient. Where there are but one or two sections to operate with the reversed potential, the switchboard described may care for them satisfactorily. If one generator is made to build up with reversed polarity, and is coupled into the auxiliary bus, it will handle such feeders as may be thrown upon it as the negative side of a three-wire system. The generator may have its residual charge reversed in a number of ways, one of which is to have the shunt field wired through a double-throw switch on the machine, arranged to disconnect the field coils from the armature, and connect them in the reverse direction to a pair of charging wires fed from the switchboard. The machine may have its residual charge brought back to the usual direction by the commonly used means of throwing in the positive and equalizing switches with the negative open, and allowing the current shunted from the series coils of the other machines to energize its series coil. Where three-pole switches are used on the generators the shunt-field double-throw switches may be omitted, and the field reversed through the series coil by using an X-shaped pair of contact pieces insulated from each other at the point of intersection. These may be pressed against the switch jaws in such a way as to reverse the current shunted from the other series coils through that of the machine to be reversed. Where the three-wire system is the regular system of operation, and the sections are divided equally between the two sides of the system, a regular three-wire board is preferable. For a less general use of the system the method described answers as well. The arrangement then becomes the same as that of the "special generator" with the polarity reversed, and the potential on the machine may be raised above normal, and the advantages of greater allowable drop in the copper added to that of the saving in track drop due to the reversed current flow.

The writer has said that the value of the three-wire system in railroad service has been considerably overestimated. This statement probably needs explanation. In lighting work the three-wire system saves 62½ per cent. of the copper. Each wire has to be but one-fourth as large as with the two-wire system, but it is usual to make the neutral of the same size as the other wires, thus requiring three wires, each of one-fourth the size of those of a two-wire system, hence the use in a three-wire system of three-eighths, of 37½ per cent. of the copper necessary in the two-wire system. Because this is true of lighting work, it is often assumed to be true of railway work. It is not, however, and in no case where the track renders any appreciable service as a conductor can the saving from the adoption of the three-wire system approach the above figures. In general its use will make a gross saving of the loss in track (assuming that there is no copper paralleling the track that may be used as a positive feeder). The net saving will be this gross loss in track, less the track losses due to the passage of current from car to car, and of the excess of current due to lack of

balance, back to the power station, and the increased overhead loss due to the greater drops in the divided feeders than in them when combined. The sketch, Fig. 2, may present this more intelligibly. It illustrates the simple case of an unbalanced three-wire system, and shows that its losses aggregate 4100 watts under the particular load. If this system were changed to a two-wire one by throwing the two feeders in parallel it would save 400 watts in the feeders and lose 800 more in the track, leaving a net loss of 400 watts, or about 10 per cent. of the total loss. Such a difference as is shown by this hypothetical case would not justify the complication introduced by the system. The only conditions where the method seems to be applicable are those of excessive track losses with fair opportunities for balanced load. Such a case existed on the Lowell & Suburban road. They have a very heavy business over a double-track line to their park, some 6 miles from the power station. By changing to positive feeders those formerly used as overhead returns, and operating the line as a three-wire one, they very greatly improved the efficiency of the distribution system.

In the selection, from the various systems of distribution, of the one best adapted to a particular instance, there is always a large number of variable factors to consider, and usually more or less speculation as to the values of certain ones on which no accurate data are accessible. This makes it impossible to work from fixed laws, and demands individual consideration of each case. For these reasons there is considerable room for divergence of opinions in the matter. The writer has given his idea as to the comparative infrequency of cases in which the three-wire system is desirable. The booster has a very much more general application, and is suited to a greater number of cases than is anyone of the other systems. Nevertheless, wherever work can be satisfactorily handled by a special generator it should be, unless the change involves abandoning existing apparatus. The last method saves considerable over the booster, and is preferable for its simplicity. The only limiting condition to its use is satisfactory regulation.

The alternating-current system, with rotary converter sub-stations, competes with the booster and special generator in cases where the load factor (the ratio of average to maximum load) is high, and where the regular 500-volt transmission will suffice during only a few of the twenty-four hours. In such a case the copper losses, because of the length of time during which they are excessive, are so great that they may often exceed the entire expense of an alternating-transmission system. The latter system also enters into competition with the independent power station for that class of business that is too remote for an existing station to admit of satisfactory handling by the other transmission methods, and too small to furnish load for such a station as may approach in economy the station from which the alternating transmission would be operated. Cases of each kind arise with city roads, in their needs for transmission to suburban centres of load, and with interurban roads.

The roads which the city station receives from the suburban centres have usually a very low factor. At morning and night they are excessive, and through the remaining hours comparatively light. Were an alternating-transmission system installed for such use it would probably lie idle for a large part of the time, its copper being used to transmit direct current. During the heavy hours it would be called into service. This same service might be rendered by raising the voltage on the direct-current feeders by use of the special generators, and allowing the loss, which has been from 5 to 10 per cent. during the light load, to become 25 or 30 per cent. In this way the line may carry three or four times as much current and maintain the voltage at the distant end.

In comparing the systems, it is necessary to compute the annual cost of each, including the items in the following list:

ALTERNATING CURRENT.

Fixed charges and repairs on main station static transformers, if any, and on sub-station static and rotary transformers and accessories.

Fixed charges on sub-station land and buildings.

Sub-station labor.

DIRECT CURRENT.

Interest, depreciation and repairs on such increased cost of engines and generators as is occasioned by their being fitted to furnish increased voltage.

Cost of fuel to produce output, representing difference between losses in direct-current feeders and those in alternating current feeders and transformers.

This assumes that the same amount of copper is used in each system; that the alternating system does not remove the need for sufficient copper to handle the load with direct current during a part of the time, and that this amount of copper will suffice for heavy loads by means of the increased direct-current potential transmission. Should the load be of such a nature that the alternating transmission would be operated throughout the whole time, there may be a correction made in its favor of the annual cost on the increased amount of copper necessary for the direct-current system over that for the alternating system. It is probable that the direct-current generator and engines need not be increased in cost more than 10 per cent. by the requirements of the increased voltage. The writer has said that he is operating satisfactorily with machines designed for the standard voltage. Points which should be made against the alternating-current system, which cannot be given exact money values, are the danger to life from the increased voltage, lack of uniformity in equipment, making lack of flexibility in stations (where, under the other arrangement, any generator may serve any demand), and the danger of delays due to the increased complication of the system, it sometimes requiring fifteen or twenty minutes to start the sub-station machinery, and get it into service after it has been stopped in the midst of load by accident. These points of disadvantage are very important ones, and operating companies can well afford to expend considerable money to avoid them. Especially is it undesirable to install for railroad work a system which may be disturbed by the extreme overloads such work introduces, and which cannot be restored to an operative condition immediately the load is brought within bounds. With the rotary-transformer system, any short circuit or extreme load which is not relieved by the sub-station direct current breakers may stop the rotaries and shut the power off the line during the long interval it takes to start them and put them into service.

In the comparative estimate the results depend more upon the load factor than any other condition. With it sufficiently high, the alternating transmission may show an economy over the direct current for areas within a very few miles of the power station. Unfortunately, however, the yearly load factor is usually very low on railroad work. With such a condition, it is cheaper to have excessive losses in copper at times of heavy loads than to carry the necessary equipment of alternating-transmission apparatus to keep the losses down at such times. The railroad manager naturally insists that the voltage be maintained reasonably near its normal value over the whole road at times of heaviest business. Estimates that show immense costs for copper to accomplish this under the regular distribution system make him turn to the consideration of additional power stations and multiphase transmissions. If he can be shown that he may care for his maximum loads over the existing copper by simply raising the voltage on the station end of the sections of heavy loss, and pay for the loss with coal, instead of with interest and depreciation of a great amount of additional machinery, he is likely at least to determine carefully which he can better afford to do.

While, in the writer's opinion, the majority of cases may be best handled by direct-current distribution, there are many instances of need for a distribution system where none but the alternating-current system is applicable. Where water powers are used, they are almost always so remote from the centre of load that very high potentials must be used for economical transmission. Long inter-urban roads operating so few cars that load can be had for only one power station bring a condition where distribution must be accomplished by sub-stations on the alternating system. The Lowell transmission presents a case where it was a problem whether to care for the new territory with a separate station or to transmit from the existing station. So much has been written about the multiphase-current system that was decided upon and installed there, that is it unnecessary to attempt a description of it. Mr. Sullivan, the general manager of the company, has kindly furnished the writer with a copy of the estimates from which the choice of systems was made. He states that operation justifies the estimate in its statement of the cost of the multiphase system. It showed the cost of power delivered to the trolley wire to be for

the transmission system 70 per cent. of that of the separate power station. There were no figures showing what this work could have been done for with a booster system. Inasmuch as the latter method has been used successfully in place of the other, temporarily, it would be interesting to know its comparative cost. Tests of the Lowell system extending over eighteen days show an all-time efficiency of 70 per cent. as measured from alternating-generator output to rotary-converter output, the losses being those of two sets of static transformers, line and rotaries. The maximum efficiency for any one day was 73 per cent. The voltage regulation at the sub-station is about equal to that of a well-governed steam-driven power station.

The writer has said that the use of alternating currents for ordinary electric railways is limited to the rotary-converter system. This is due to the fact that alternating-current motors, in their present state of development, are not adapted to the needs of such railways. As yet their use for traction purposes is limited to a few European roads, of which the best known is in Lugano, Italy, Alternating motors have the disadvantages of limited torque and tendency to synchronism. This makes them poorly adapted for the uses of any line but one having long runs at practically uniform speeds, and few stops. These conditions are those of a through express service between cities. Accommodation and ordinary street railway service are such as can only be handled satisfactorily by direct-current motors. At first notice this fact seems rather contradictory to one's ideas of the flexibility of alternating currents. The ideal system has been thought to be one composed of a generating station containing large multiphase generators, with lines distributing current at a potential high enough to require but a comparatively small amount of copper, static step-down transformers, and motors that may be regulated throughout all desired variations of speed by merely changing the impressed E. M. F. with a controller depending upon the use of various ratios of transformation. This dream included the freedom from the cars of commutators, and pictured a car equipment that would need a minimum of attention. Were it possible to realize all of these advantages, it is probable that the somewhat serious complication introduced by the necessity for two trolley wires might be tolerated. There seems to be little possibility, however, of an early solution of the problem of adapting the alternating motor to the intermittent work of the street railway.

In conclusion, the writer desires to say that the title of this paper may have led some to expect rather more particular attention to the multiphase transmission system, and less about direct distribution. He has, however, given the various systems the same relative importance in the paper that he considers them to have in application. Hence, the subordination of the alternating-current system in the consideration of the general subject of power distribution.

Application of the Storage Battery to Electric Traction.*

BY CHARLES HEWETT.

To give a history of the application of the storage battery to electric traction would only be turning over dry bones. The long series of remarkable failures is no doubt familiar to all. To say that the storage battery has no place in electric traction is an error, and on the other hand to say that it will supplant all other means of applying power to the cars is, I believe, only the dream of the enthusiast. We are sufficiently acquainted with the possibilities and limitations of the storage battery of to-day to be able to make installations whose success will be certain. Improvements in manufacture have certainly been made during the past few years, but the cause of past failures has been due quite as much to errors in installation and in manipulation as in manufacture.

The most important applications of the storage battery to electric traction are:

1. The application of the battery direct to car or locomotive. 2. The application of the battery at points on the line distant from the generating station. 3. The application of the battery in the power house.

*Extracts from a paper read at the convention of the American Street Railway Association, Niagara Falls, October, 1897.

THE APPLICATION OF THE BATTERY DIRECT TO CAR OR LOCOMOTIVE.

We are led to consider this form of application first, not on account of its sucesses, but rather on account of its conspicuous failures. From our investigation we can see nothing in this form of installation to commend, except for certain local conditions, which are peculiar to the large cities on the continent of Europe.

The first cost is greater than our present overhead form of construction, and the expense of operation is considerably greater; in fact, it is doubtful whether the expense of operation can be brought below that of horses. It is less reliable, and more objectionable to passengers on account of the gas given off. But very little reliable data are obtainable from all the various experiments which have been made. Most of such experiments, in this country at least, have been made by battery manufacturers, and the results obtained have been most carefully guarded.

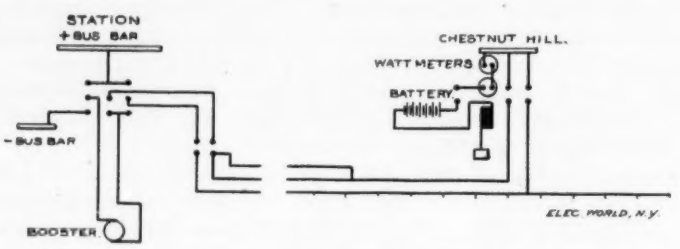
In a paper read by the writer before the Engineers' Club, of Philadelphia, December 5, 1896, I gave in detail results of a test made by me of a certain battery car. The main results agreed quite closely with data which have come to us through European publications, and I feel confident in stating that the battery car requires considerably more power to operate than an ordinary trolley car of the same size and under the same conditions, and, further, the battery car will require a larger investment in generating machinery. The unreliability of the battery car, and the disadvantages due to the necessity of constantly changing the batteries are familiar to you all, and we have no facts which would warrant us in holding out any hope of improvement in this line. In fact, unless some form of battery be discovered with entirely different characteristics from the lead battery, I should advise leaving such experiments to those who enjoy spending money on this kind of a hobby. When the action of the battery is thoroughly understood it is not difficult to understand the cause of failure. Every battery has what may be termed a critical rate of discharge. From zero up to the critical rate the working E. M. F. remains practically constant. Above the critical rate the E. M. F. decreases as the rate of discharge increases. On the other hand, the E. M. F. increases with the rate of charge and the length of charge. For any particular battery there is a rate of charge which cannot be exceeded without useless waste of energy. In Fig. 1 I have shown typical curves for charge and discharge at normal or critical rates and the portion between the curves represents lost energy. In Fig. 2 I have shown the discharge curve taken from a traction battery test. With a fairly constant discharge at the average rate used by the car, with rests of one minute every fifteen minutes, the fall of E. M. F. is very marked. You will appreciate therefore the remark of Sir David Salomon, "that it takes power to get current through the battery, and it also takes power to get the current out." These critical rates of charge and discharge seem to be partly due to the time required for the chemical reactions in the battery to take place. The physical limitations of a car require the battery to have a large output for its weight and bulk. To obtain this it is necessary to increase the surface of active material as much as possible and to decrease the inactive supporting grid. In consequence the battery plates become mechanically weak. The conditions seem to prevent the making of plates large enough to prevent exceeding the critical discharge rate, and at the same time light enough and small enough to be carried on a car. The inherent characteristics of the lead battery are such that it is very doubtful whether it will ever be successful in propelling cars unaided by other sources of power. Great results are expected from the experiments now being made in Chicago, but great results have been expected before, and I do not look for results in Chicago much different from those that have preceded.

There is another phase of this method of application which is used somewhat extensively in Europe. In some of the larger cities on the Continent there is a prescribed area within which overhead lines are not allowed. To overcome this difficulty the cars are supplied with batteries sufficiently large to propel them at a low rate of speed for a distance of 3 or 4 miles from the point where the overhead line ends, into the city and return. While the cars are completing the trip the batteries are charged from the overhead wire. I am sure such an arrangement would not commend itself to any practical railroad manager, except as a makeshift in such government-ridden cities as exist in Europe. The advantages of this method are apparent. Aside from the objection to overhead

lines in the crowded city centre, which is purely aesthetic, the most marked advantage is the lack of necessity for changing the batteries for charging. But this advantage is offset by the fact that the current for charging, in addition to the current necessary for propelling the car with its extra weight of battery must be transmitted over the feed wires, thus increasing the loss due to charging. There are only two cities in this country where such an arrangement might reasonably be considered, and in those cities the slotted conduit has (and I believe wisely) been adopted.

The fact that overhead lines are in use up to the prescribed limit and that the battery is only used where it is compulsory, speaks volumes. It is also significant that the commission appointed by the larger roads in England and Scotland to investigate the various methods of traction in vogue throughout Europe and America have vetoed any form of battery car.

A third phase of the battery-car system is the battery locomotive. Aside from special forms, such as the Heilman locomotive, the one most worthy of mention is the experiment on the New York Elevated Railway, in which the battery is connected in multiple with the line, and charges or discharges according to the demands of the train. When the demand of the motors is sufficient to lower the pressure on the line to or below that of the battery, the battery will then discharge into the motors, thus relieving the feeders. When current is shut off from the motors, the battery will charge. No results of this experiment have been made public yet, but it is difficult to see how much is to be expected. It has the advantage of maintaining a fairly constant pressure at the motors, but this can be accomplished better in other ways, as I shall show later. It subjects the battery to usage which history has proved to be disastrous to its life and efficiency. In this method the extra weight of the battery has the certain advantage of giving additional adhesion to the rails. While not wishing to seem pessimistic, I must confess that to me the outlook for the battery car is not bright, and I do not look for much improvement unless some combination of elements be discovered whose characteristics are entirely different from the lead battery.



Connections of Union Traction Company's Sub-station.

THE APPLICATION OF STORAGE BATTERIES ON THE ENDS OF LONG LINES.

In such applications the conditions are entirely different. The battery in this case acts essentially as a pressure regulator. The conditions do not restrict the size of the plates, so that the plates can admit of such a size that the current density on discharge can be kept well within the limits of normal discharge; and in consequence of this the battery is not subject to the great loss of efficiency due to the fall of E. M. F. on discharge. Only a few such installations have been made, two of which are on the Isle of Man; one has been installed by the Anaconda Mining Company, at Butte, Mont.; there is also a small plant at Merrill, Wis. The first installation, however, that has been made from any large city road for its suburban service, I find, is the one installed by the Union Traction Company, of Philadelphia, Pa. The road was originally a horse-car line which ran as far as the depot at Pelham, a distance of 7.3 miles from the power house. Conduits and cables which were supposed to be amply sufficient were installed for operating a number of cars. The phenomenal increase in the travel, however, necessitated a large increase in the car service. In addition, the success of the line warranted its extension to a point 11.2 miles from the power house. The drop in pressure over this long line made it impossible to run the requisite number of cars, as the speed of a trolley car is approximately in the direct ration to the applied E. M. F.. The investment in feeders for this line had reached a point considerably above $100,000, not including the conduits. To have increased the cable system so as to have supplied this section properly would have required about 336,000 feet of 1,000,000 cm cable.

The drop was very great. At Chestnut Hill 350 volts was frequently touched. The average was a little over 400 volts, with 530 at bus bar. If a station had been built at that point it would of necessity have been small and inefficient. A station of 750-kw capacity would have cost about $85 per horse-power, or a total of $85,000. A battery station, on the other hand, required but little real estate, and would be inexpensive to operate, and its cost would be considerably less than a power station. In the Chestnut Hill plant the entire cost of real estate, battery and building was approximately $25,000; to which must be added the cost of a booster in the main power house. In this installation, however, they simply adapted a 300-kw generator to this service, so that they were put to but little extra expense in the power house for adapting it to booster purposes. If we, however, deduct $33,000, the cost of the battery and booster, from $85,000, the cost of a station, the difference in first cost is $52,000 in favor of the battery. In addition to this, they were put to an expense of a little over $13,000 for changes in the cable.

You will see by the figures there are three cables concerned in this work, which are all of 1,000,000-cm capacity; the lengths of these cables are shown on the diagram, and only one supplies the trolley wire direct. This cable runs all the way from the bus bar at the power house to the end of the line on the Reading Pike at Chestnut Hill. The other cables run direct from the power house to the bus bar at the battery house, as shown in the diagram. In ordinary operation the current on these cables passes through the booster at the power house, by which the initial pressure is raised 150 volts more or less above the ordinary bus-bar pressure of 550 volts. By this means the drop in the cable is overcome, so that the pressure at the battery house can be adjusted to a point where the battery varies but little to either side of the zero point, or in other words, it charges and discharges continually, maintaining the load on the cables nearly constant, and consequently maintaining a constant E. M. F. where the current passes out from the battery house. The line is therefore fed from two points, namely, from the power-house end at 550 volts, and from the Chestnut Hill end at about 515 volts. As a consequence the distribution along the line from Wayne Junction to the end at Chestnut Hill is comparatively uniform and is now very satisfactory.

At first the battery was allowed to discharge during the day about three times as much as it charged, making up the charge at night between the hours of 1 A. M. to 5 A. M. Later, the amount of the day discharge was decreased until the charge and discharge were about equal. The first gave a very even voltage of a little over 500. With the present method the voltage is somewhat more irregular, but the average is somewhat higher. By keeping the battery continually up to full charge the night man has been dispensed with. When the load on the line is low the current going to the battery house divides, one part supplying the line, the other part charging the battery. When the demand on the line is heavy the pressure drops a little at the battery house; all the current from the power house passes out to the line, and, in addition, the battery discharges sufficiently to make up the extra demand for current.

During the month of May, 1897, the battery house delivered to the line 103,053 kw hours. Estimating the cost of local generation of this power at 1½ cents per kw hour, and adding interest, depreciation, etc., gives the cost by local generation method for one month $2454.

The actual cost by the battery method, including depreciation, etc., and central station power at 0.6 cent per kw hour was $1100, showing a saving of $1300 per month by the use of the battery.

This method of power distribution cannot be considered economical *per se*, but where the conditions are such as we have described there is no question as to the economy in favor of the battery.

APPLICATION OF BATTERY TO POWER HOUSE.

This form of installation has not become very generally appreciated in this country, and but few installations have been made. As its advantages become better known, I feel confident the practice will become more general. The wide fluctuations in load in railway power houses are now well known. The average daily load varies from 50 per cent. of the maximum in small stations to 70 per cent. of the maximum in the largest stations. From a very large

number of observations in all parts of the country I find that in the majority of stations the average load is very close to two-thirds of the maximum load. Now, it is also a well-known fact that the maximum economy of the steam engine exists for a very small range of load, and that on each side of the point of maximum economy the efficiency falls off; rapidly on the overload, somewhat less rapidly on the underload. The result is apparent. In most stations the engines, at the best, have an average load of only two-thirds their most efficient load, and as a consequence consume over 4.5 pounds of coal per kw hour. With badly regulated engines, and especially with water-power plants, the changes in load are acompanied by variations in speed and consequently in voltage. These troubles may be entirely corrected by installing a battery.

The battery in this case becomes distinctly a load regulator. It is necessary that the capacity of the battery should bear a larger ratio to the output of the station than is necessary for potential regulation as described in the previous section of this paper. In potential regulation a comparatively small battery is necessary, since by changing the potential of booster from time to time during the day the charge and discharge can be kept very low. In the case described a battery rated at 120 amperes has successfully regulated a total output of 1400 amperes. For load regulation, however, the battery should have a capacity equal to one-third the maximum output of the station. The average load of the station may then be made the maximum load of the engines, the battery taking care of the fluctuations. As in the previous case, there are no physical limitations to be placed on the size of the plates to be used, and the charge and discharge may be kept well within the narmal rate. Under such conditions the efficiency of the battery is high—85 to 90 per cent.—and the deterioration very low. In most cases no additional labor will be required.

Application of Electricity to Railroads Now Operated by Steam Power.*

BY N. H. HEFT.

The New York, New Haven & Hartford Railroad Company owns and controls about 2800 miles of main line railroad track in New York, Massachusetts, Rhode Island and Connecticut, of which about 16 miles are operated by electricity on the third-rail system and 14 miles on the overhead-trolley system.

The first line to be equipped by the New Haven Company was a purely summer road, operated for about four months in the year only, through a narrow peninsula running out from the mainland on the Massachusetts coast fom Nantasket Junction to Pemberton, a distance of about 7 miles of double track. This line was chosen partly because the main line operation would not be interfered with in case of trouble with the electric trains, and partly because of the existing heavy summer traffic which would put the new apparatus and the feasibility of the entire system to a severe test. An overhead trolley line was built, with centre-pole construction, and everything made very strong and more substantial than was at that time found in any street-railway work, to our knowledge.

The line was operated for the first summer with excellent success, and all fear of trouble having disappeared, an extension of 3.6 miles was made on the main line of the company's Plymouth Division, this section being operated by the third-rail system.

In December, 1896, we commenced work on a new line running from Berlin, Conn., through New Britain to Hartford, a distance of 12.3 miles, 3 of which, from Berlin to New Britain, is a double track, and the remainder, from New Britain to Hartford, a single track. A power station was built at Berlin, one end of this line, partly because of a desire to test transmission of power to a considerable distance, and partly because Berlin is the centre of several radiating lines, which may eventually be put into operation by electricity.

We have learned very thoroughly, in our street railway experience, the lesson of the importance to any transportation agency, working in a thickly populated territory, of uniform fares and a frequent and regular train service—of a train service which requires no printed schedule to enable people to know when cars may be found in waiting.

On its Nantasket Beach line, the New Haven Company gave, during the last summer, a regular half-hour service from 6.30 in the morning until 11.30 at night. The fares charged on the Nantasket Beach line before the advent of electricity were 10 cents from Pemberton to Nantasket, and 18 cents from Nantasket to East Weymouth, a total of 28 cents from Pemberton to East Weymouth. With electric traction they have been placed at a uniform rate of 5 cents from Pemberton to Nantasket, and 5 cents from Nantasket to East Weymouth, a total of 10 cents from Pemberton to East Weymouth. Under these new conditions the traffic has increased enormously on this line; the summer of 1895, the first of the electrical operation, showing an increase of 92.6 per cent. over the previous summer in the number of passengers carried; the summer of 1896 showing 45.1 per cent. increase over 1895, while in the summer just passed we have carried nearly three times as many passengers as in the last year of steam operation.

The operation of the line from New Britain to Hartford was commenced in May last, with a regular half-hour train schedule from 6 in the morning to 11.30 at night, and with a uniform fare of 10 cents each way, instead of 23 cents, the former charge. The electric line carries through passengers only between Hartford and New Britain, the passengers for the five way-stations being carried by the regular steam trains running on a parallel track. For ordinary everyday service a single open-motor car was used during the past summer, while for extra loads light double-truck trail cars seating seventy people were attached. On rainy days a standard close passenger coach was hauled by the open-motor car. On holidays and Sundays the cars pulled two trailers, the entire train seating nearly 250 passengers. About the middle of August steam service on the Berlin-New Britain branch was discontinued, and the traffic has since been handled entirely by electricity. Sixteen trains each way per day are run, connecting with steam trains.

Under the conditions named on the Hartford-New Britain line we have carried during the three summer months 400 per cent. more passengers than we carried through the corresponding months of last year.

I do not suppose that any but a trained railroad man can understand the impossibility of operating trains and maintaining schedules by steam locomotives in the way that has been done by electricity at Nantasket Beach this summer. There are a great many curves on the line and several grades. There are no excessively sharp curvatures or steep grades, and it is not here that the trouble has come. The difficulty is found in the fact that there are no less than seventeen stations on a line only 10.6 miles in length, or an average distance between stations of but about 0.6 of a mile. To make a run of 10 miles with sixteen stops in twenty-six minutes; to be obliged to do this in order to connect with boats arriving at regular half-hour intervals, and to keep out of the way of frequent regular steam trains on the main line of the Plymouth Division; to allow but four minutes at each end for unloading, switching (including running around trail car), and loading, and to do this day in and day out, in regular service, through an entire summer—these are things which cannot possibly be accomplished by steam locomotives.

Now the reason why electricity can do this and steam cannot is found in the tremendous accelerating power of properly designed electric motors, with rotary motion as compared with reciprocal motion of steam locomotives. A 60-ton train, for example, in running from Windermere to Allerton, a distance of only 1800 feet, reaches a maximum speed of 31 miles per hour, while in the longer run from Power Station to Nantasket Junction, a distance still of but 5808 feet, a maximum speed of 39 miles is reached. The entire distance is covered, in regular service, at an average speed of 24.6 miles per hour, including stops.

Between Hartford and New Britain the 9.3 miles distance is covered regularly by motor cars with two trailers in from 18 to 20 minutes, an average speed of from 28 to 30 miles per hour, while, with a special high-geared motor, a maximum speed of over 60 miles has been made; the entire distance of 9.3 miles being covered in ten minutes. On this line a 52-ton train often reaches a maximum speed of 50 miles per hour. The current is cut off at twenty-nine grade crossings when single-car trains are run.

It is worthy of note, in this connection, that the line between New Britain and Hartford is in direct competition with a trolley line between the same points, but following a more circuitous route. The schedule time of trolley cars is fifty-five minutes, as against our time of less than twenty minutes, and the rate of fare is 15 cents (including a transfer given for use on the street railways of either city), as against ours of 10 cents for the straight run between the two cities only. The ownership of right of way has a very important influence upon speed and competitive conditions under circumstances like these.

*Abstract of paper read at the convention of the American Street Railway Association, Niagara Falls, 1897.

The type of car selected for any good transportation service has a direct bearing upon the development of traffic and maximum gross receipts. It has been difficult for steam railroads to depart far from the long-established custom of closed passenger coaches of the present standard type, and to adopt open cars, on account of the disagreeable effect on passengers of the smoke and gases from engines. This has naturally thrown a great deal of traffic to competing street railway lines running open cars in summer, on account of the greater comfort of the open car.

With electric operation open cars in heavy railroad practice are possible, even at considerable speed, particularly if the front of the car is closed in with glass, and both at Nantasket Beach and on the Hartford-Berlin line we have used heavy open cars with great success.

The motor-car, which we have so far used, we do not consider, by any means, the final type, and even now we have in mind plans of combination cars which we believe will be, on the whole, well adapted for railroad work. The present motor car is very heavily built, with floors of a height equal to that of our standard passenger coaches. It contains sixteen cross seats, capable of seating ninety-six passengers, and the entrance is from either side, with three steps. Each car has two heavy railroad trucks, one of which is equipped with two 125-hp motors. The total weight of the motor car is 32 tons, and the trailer car of the same type weighs 25 tons. The motors which we have used up to date have been of a type common in heavy elevated railway work. These motors have often been in service for several consecutive days, making 325 miles each day, without apparent injury. We found the motors we are using already in the market when we commenced our experiments, and until recently no attempt has been made by us to specify changes. The experience gained with these motors has served as a basis for building larger and heavier types, better adapted for the severe work which they will be called upon to fulfill to meet our requirements. An important point which we shall specify in new motors is that they shall have the most perfect ventilation possible. The efforts of manufacturers have been hitherto directed toward completely encasing the motors, so as to make them waterproof, but in doing this ventilation has been sacrificed.

We have found it beneficial to blow out our motors several times during the day by means of a blast of air from a hose pipe connected to our air-brake reservoir, but this is, at best, but a makeshift.

It is very difficult to dispose of all the necessary cables, wires, brake rods and chains, air-brake cylinders and apparatus, switches and other car controlling mechanism in the limited space beneath the car floor, as may be readily imagined by those familiar with street railway work. As a consequence, there has always been more or less controversy between those responsible for the placing of the different portions of the equipment as to who shall have the first right to a given space, perhaps hardly a half a dozen square inches in section. There is also more or less trouble with abraded wires, short-circuited shoe hangers, etc., and for our future work we are making an effort to simplify this mass of equipment mechanism by putting some of it, particularly the wires and cables, in a space between the true floor of the car and a false floor several inches below, specially provided for the purpose.

For operating heavy trains of this character, where currents of from 500 to 1000 amperes are sometimes used, the controlling apparatus must be massive and strong in every part, and the greatest care must be taken to prevent arcing. We have had no trouble with controlling apparatus on our regular equipments, and we consider this branch of the apparatus well perfected.

The danger to station and car apparatus from lightning discharges, which is so important a factor in street railroading where the overhead system is employed, is avoided in third-rail work, since the third rail is so close to the ground that it is practically a lightning arrester itself throughout its whole length.

The problem of breaking, which is so important in street railroading, is even more so with us, since the train weights and speeds are enormously greater. The regular Westinghouse air-brake system, with engineer's valve, is used on our electric trains, but instead of steam air compressors we have an electric motor-compressor, controlled by an automatic regulator which has given excellent satisfaction.

Our experience with trolleys on the overhead line at Nantasket Beach, originally put in two years ago, has not been satisfactory. We find it quite impossible to prevent the destruction of trolley wheels by almost continual arcing when attempting to take from the wire the heavy current required in starting and during acceleration, as well as the smaller currents taken at the maximum speed. There has been a good deal of trouble, moreover, in keeping the trolleys on the wire in making speed and taking curves, and many trolley poles have been broken. The trolley difficulties have not interfered with the continuous operation of our line, but the cost of replacing wheels and poles has been rather large.

These difficulties have had an important influence in causing us to reach a decision in favor of the third rail. The contact shoes, which take the current from the rail to the motor circuit, have given, on the whole, good satisfaction, although they are occasionally carried away by the approach blocks at grade crossings when these blocks happen to be slightly misplaced so that the shoes strike them at the wrong angle. The contact shoes are suspended by cast-iron links, which are intended to be weak enough to allow the shoe to break away easily without doing damage to the framework of the car. The trail cars are also equipped with shoes and connected with the circuits on the motor car by means of flexible couplings, and it is possible therefore, when the cars are run in train, to bridge the longest gaps found at grade crossings and switches, so that it is not necessary to turn the current off on approaching these. This arrangement makes our trail cars independent of the motor car for heating and lighting.

It will be noted that the Nantasket cars have two trolley poles, as well as contact shoes, and the change from trolley to third rail simply means the pulling down of the pole and the closing of the third-rail switch.

Our third-rail and return-circuit experience will perhaps be of value to both street railway and railroad managers, as we have undoubtedly made a wide departure from established methods.

First is the question of insulation. The third-rail has a potential of 600 volts above the ground and rests upon creosoted wooden blocks dowelled into the ties, its eaves being only 1⅝ inches above the tie. Now it frequently happens that water accumulates 2 inches or more in depth over the ties, and, if it were not for our experience to the contrary, we would naturally suppose that, under these circumstances, the line would be directly short-circuited between the third and service rails through the water, the distance being but about 2 feet each way. Nevertheless we have been able to operate our road without the slightest difficulty when this has happened, and nothing unusual has been noticed at the station, nor has the electrical output, as registered by the recording wattmeter, been abnormal. At Berlin we have watched the ammeter closely when we knew the tracks to be submerged in two places 10 miles apart, during a heavy rainstorm, and have found that the leakage was almost imperceptible when both cars on the line were at rest and their air pumps out of circuit. At that time the wattmeter was standing still. Of course, if a long length of track were submerged the leakage might become serious, but we have yet to learn how much is necessary to accomplish this result.

We aim to so connect our third-rail lines and the service-rail return as to have a practically complete metallic circuit of extremely low resistance; as far as possible, insulated from the ground. We do not believe in grounding our track, and, though ground plates are placed at the station, connected to our generator, by far the largest proportion of the return current comes through the cables connected directly with the track, the percentage coming from the ground plates being extremely small.

The joints of the third rail are bonded by long copper plates, firmly bolted to both sides of the joint, sixteen bolts being used in all. These copper plates are tinned before being put into position. Owing to the large area of contact surface, the presence of rust on this surface does not materially interfere with the conductivity of the joint, as shown by accurate tests.

The service rails are bonded with the greatest care, four copper leaf bonds, having a cross section of copper equal in conductivity to that of the rail, being used. These bonds are inserted in the base of the rail instead of the web, so as to prevent breakage through play at the joints. The copper leaves are cast into end-piece blocks in such a way as to weld them thoroughly together in the blocks. The latter are formed into a hollow cylinder, 1 inch in diameter, which passes through a hole in the flange, and by which a large area of contact is secured. Taper pins are driven into the inside of this cylinder from the top of the flange, and the connection made is very perfect. Careful tests have shown that the joints of both third and service rails have now a slightly greater conductivity than an equal length of the rails themselves.

A few words about the danger of the third-rail system would be, perhaps, in order. There have been many cases of people who have stepped from the ground to the third rail without feeling the current, and anyone can step upon it from a dry tie without the slightest effect. On all except wet days our employees work about it without trouble, avoiding, of course, putting themselves in direct contact with both service and third rails, but not infrequently "monkeying" with the current in such a way as to get shocks of more or less severity in a sort of horseplay. On wet days they refer to the third rail as being "lively," and are inclined to let it alone. Many of our employees have, however, received the heaviest shock possible to obtain, time after time, and care little about it, though those who are more influenced by electric shocks than others are sometimes thrown off their feet, but recover fully in a few minutes. We do not say that the third rail has no dangers, but we do not consider the danger as being at all serious, or one which should interfere with the extension of the system.

As a result of exceptional care which we have taken in bonding our third and service rails we have found it unnecessary, in any third-rail work so far done, to use copper feeders, in spite of the fact that we are obliged to transmit current from Berlin to Hartford, a distance, as before stated, of 12.3 miles, straight away from the power station. This work is made up as follows. From Berlin to New Britain, a distance of 3 miles, there is a complete double-track electric road, with two 100-pound third rails and four 74-pound service rails, all most carefully bonded as described above; from New Britain to Hartford, a distance of 9.3 miles, there is one complete electric track, with 100-pound third rail and 70-pound service rails, all carefully bonded, in addition to which we have connected to the service rails of the electric track the rails of the second track, paralleling this the entire distance, at various places, in order to get the benefit of whatever conducting power there might be in this track connected only by its fishplates at the joints. As a result of this work, we are able to run two trains of 52 tons each on the New Britain and Hartford line, with an average loss of but 26½ per cent. The current output of the station at such a time averages about 300 amperes, with a maximum flow og about 700 amperes at a pressure of 600 volts. Of course, if the service were heavier, so that more cars would be required, it would undoubtedly be necessary to reinforce the third rail with feeders.

In spite of the fact that the general conditions of operation do not point to a low cost of power, because of the fact that we are working neither station at anywhere near its full capacity, I suppose we are, as a matter of fact, producing power more cheaply than can be done in any power station in the country using coal as a fuel, the reason being that we are burning sparks. "Sparks," as we are accustomed to call them, are the half-consumed coal dumped from the extension front of locomotives at the company's various round houses. Nevertheless, there is a great deal of steam-generating value in these sparks, as we have found by experience, and they are being carried on the company's cars to our stations at Berlin, Nantasket and Stamford, and charged to the electrical operation at the cost of freighting (including the usual profit to the company for transportation), plus the cost of loading and unloading, a total charge of 70 cents per ton delivered.

In order to burn these sparks we are obliged, of course, to make some changes in the furnace arrangements, chief among which is provision for the introduction of live steam under the grates, forming a blower or forced draft as well as providing the water which, in decomposition, furnishes the oxygen and hydrogen gases which increase greatly and facilitate in combustion of half-burned coal and add enormously to the furnace heat. We originally supposed that some form of shaking or self-cleaning grate would be necessary in burning sparks, but have found in practice that, with ordinary grates together with the steam blower, there is no difficulty. In our experimental days, it was thought that it might be necessary to use a proportion of ordinary soft coal with the sparks, and we did so for a while, but it was not long before our firemen were educated to burn sparks only with entire ease, and no other kind of fuel is now used by us. Of course we have to use a greater weight of this half-consumed coal than would be the case with new coal, but still the economy is great, as a good quality of run-of-mine coal costs us, in Connecticut about $3 per ton delivered at power station.

As before stated, our Berlin plant has not been run as economically thus far as it will be when a greater load is put on the engines, and it will seem to be in the interest of economy to run compound condensing. At this station the cost of fuel, with the use of coal, has been 9 mills per horse-power hour, or 12 mills per kilowatt hour. Using sparks as fuel has reduced this cost to 3 mills per horse-power hour, or 4 mills per kilowatt hour.

It is very difficult, of course, if not impossible, to make any direct comparisons between the cost of motive power for electric railroading, and that for steam railroading, on account of the different way in which the trains are made up. The best criterion would be the cost of motive power per ton mile hauled, but even here the results would be of little value on account of the wide difference in conditions, and, as a matter of fact, we have never attempted to make such comparisons.

I have tried to give you, as briefly as possible, some of the results of the pioneer work which the New Haven Company has been doing in heavy electric railroading. They are roughly stated, and we cannot pretend that they are in any way conclusive as affecting general railroad practice. For ourselves, however, we have formed some definite ideas as to what is possible for us to accomplish, and our plans for the future are being made with great care by President Clark and the Board of Directors, with the intention of dealing with the new transportation conditions which confront us in a broad-minded and progressive way. It is felt that a great transportation agency of this character owes it to the public from which it has obtained its franchises to furnish the best possible service and to make the most of the natural advantages which it possesses.

There will always be room, doubtless, for railroads of two characters, the one operating on a purchased right of way, where trespassers can be kept away and high speed obtained, and the other operating on streets and highways, where passengers can be taken up and let off at their own doors. It is possible that, in some thickly settled districts, such as are found in New England and the Middle States, where population groups almost touch each other, these two classes of service may occasionally be performed by the same agency, but there is no reason, ordinarily, why there should not be the most amicable and friendly relations, and not infrequently of a business character, existing between steam railroad and street railway companies.

Municipal Ownership and the Operation of Street Railways.*

BY P. F. SULLIVAN.

The purpose of Mr. Sullivan's paper was more to suggest lines along which others might follow than to attempt to treat the subject exhaustively. The question was considered under the two following heads. Municipal administration in American cities is so extravagant and unbusinesslike that, in the interest of the public, the powers and duties of municipalities should be reduced rather than enlarged. Municipal ownership and operation abroad are the exception rather than the rule; and were the reverse true and such ownership and operation successful from a financial point of view, it does not prove that American cities could or should follow such examples, or that if they did so success would result.

Thoughtful men view with alarm the growth of American cities and the maladministration of their affairs. Some go so far as to believe that both conditions seriously threaten the future of the republic. To show how general and widespread are maladministration and corruption throughout the country, Mr. Sullivan quotes some extracts from the remarks of delegates to the conferences for good city government. Under the conditions disclosed by these extracts from speeches of American citizens, it is strange that men will be found who will advocate enlarging of the duties and powers of our city governments. But the theorist says: "Enlarge the responsibilities of the government and you will improve it." Acting upon that theory, the doors of every penitentiary should be opened and every evildoer therein sent back to the community whence he came.

Mr. Sullivan then refers to the ownership and operation abroad, discussing the systems in Glasgow, Leeds, Sheffield, Blackpool, etc. Among these cities the only one wherein the undertaking may fairly be called successful is Glasgow. With reasonable economy it could not well be otherwise than financially successful. With a population of over 800,000, Glasgow has only 73 miles of track, whereas St. Louis, with a population of less than 700,000, has over

*Abstract of a paper read before the Convention of the American Street Railway Association, Niagara Falls, October, 1897.

335 miles of track. Comparing many foreign cities with American cities of the same population, it is found that the area of the latter is greater, and the street railway accommodation is greater still. The English cities average 15,000 persons per mile of track, and the American cities about 2600. If, therefore, the methods of civil service and administration were the same in the two cases, the English city management could be eminently successful and the American a monumental failure.

Comparing the administration, a quotation is taken from the Rt. Hon. Joseph Chamberlain, on the relative administration of Birmingham and Boston. Although the cities are of about the same population, the annual municipal expenditure of Boston is more than six times that of Birmingham. "The public works of American cities are perhaps the field of more swindling than any other department of the municipality. Any person who inspects the annual budgets of the chief cities of the Old and the New World will be startled at the economy of the one and the extravagance of the other." Alfred R. Conklin says: "The matter of franchise is one of the most distinguishing features of American and European city governments. All the powers of government in Europe are in the hands of the property-owning class. * * * Every large American city is practically in control of the non-taxpaying element, and from this class the intemperate, vicious and purchasable vote is mostly composed. * * * Surely the alliance of the business of cities with national politics and its control by the party machine is a serious evil. It opens the way for every form of dishonesty and corruption which avarice and ambition can suggest."

Discusssing state ownership of railroads, Mr. Sullivan takes up the cases of France and Brazil. The South American republic has determined to abandon state ownership, after a thorough test of the theory, and is now negotiating for a lease of the entire system, comprising 14,000 miles of track. In France the prophecies of cheap rates, cheap freight and abundant profits made eighteen years ago on the state railroad have been dismally disappointed. The Government has every year a deficiency to settle, and the patrons of the line pay somewhat more than they would have done to a private road.

The city of Toronto, Canada, is the only instance in America of public ownership and private operation. The municipality constructs the concrete bed for the tracks, does all the paving and removes the snow. The compensation for this is much less than that paid in some cities by one company for running over the tracks of another.

Some of the Difficulties Existing in the Construction and Operation of Electric Street Railways.*

BY GEORGE W. KNOX.

With the small street railways during the panic period there has been a struggle for existence, and a road that has pulled through these times without running behind may be considered fortunate. Many an electric road now in the hands of a receiver would be making neat incomes for the investors had a closer study and practice of the principles of economy been made. Economy does not consist altogether in making one or two large reductions, but in cutting off the many unnecessary little extravagances of the system. The first and most important step is the selection of a proper corps of operators. The relative advantage of good men is enormous. In the operation of a car, a good motorman will save power, prevent breakdowns and avoid accidents, while a careless man will do the reverse. In the matter of engines and electrical machinery we have reached a state of comparatively high efficiency. There is not the chance of making the saving in these lines that there has been in the past. A general idea of what is required as to feeder requirements, cars, motors, etc., is so well understood that these problems narrow down to a study of accommodating the details of the system to the local conditions. It is totally out of the question for anyone to lay down a code of rules to be followed, owing to the varying conditions. What is greatly needed by those in charge is a better opportunity for meeting each other to discuss matters of detail in construction and operation. One of the mistakes into which we are most likely to fall is the rut of self-satisfaction. It is imperative in order to eliminate this that we brush up against the other fellow and get his ideas. The American Street Railway Association has, I believe, too much of a national character to afford the time to discuss details. There should be local associations.

Our whole aim should be to make as few mistakes in the construction as possible. As the cost of operation depends largely upon the method of construction, it is an absolute necessity that we look ahead and plan against all kinds of possible disaster, ignoring the teaching that "we should not cross the bridge until we come to it." A little foresight will be the saving of many days' profits.

Another point to be studied for economy is the supply department. There is an immense sum of money needlessly squandered in supplies and repairs for an electric road in a year. The roads have not yet arrived at a standard in design of the apparatus which they use, to which too much importance cannot be attached. The unwary railway man has had an immense amount of experimental machinery inflicted upon him, all of which costs dearly, and, if maintained, reduces economy.

Another point to be carefully studied is the selection of the motormen. The position of the motorman perhaps has more responsibility attached to it than the position of locomotive engineer. The motorman, of course, has not in trust as valuable a property as a steam railway train, but in his field of operation there is a greater risk of menace to life and property, for which his employer is responsible. I do not believe in attempting to educate the motorman to any extent in electrical knowledge. He should understand the brake mechanism, how to cut out a disabled motor and the rules given in the rule books. If he attempts to remedy complex troubles on the road he will waste time tearing apart the equipment and block the line. The cars had better be pushed into the depot and fixed up there.

In placing a man in charge of a department he should be given the full responsibility of his position. Then he will take an interest in what he is doing. If he does not try to save, much as though the saving were his own, his place cannot be filled too quickly. An attempt should be made to keep the company's property as neat and orderly as possible. The indirect effect of disorder in making men carless and neglected should not be under-estimated. In the shops there should be a place for every repair part used, from the cotter-pin of the trolley wheel to the truck wheels of the car.

One of the most commendable practices is the regular calling together of the heads of the different departments for consultation. The details and complications coming up concerning the work are so varied and numerous that verbal reports and discussion help greatly. There exists with us at times an inexcusable amount of carelessness which results in great depreciation, and there must be constant vigilance on the part of heads of departments to stop this and to make the most of every man and every dollar's worth of supplies.

*Extracts from a paper read before the Convention of the American Street Railway Association, Niagara Falls, October, 1897.

The Best Method of Settling Damage Cases and the Prevention of Accidents by the Use of Fenders or Otherwise.*

BY WILLARD J. HIELD.

Like all other professions, the law has in late years given rise to many specialists, among which the "personal injury" lawyer is most prominent to the street railway manager. His untiring efforts have wrought such a change that the question of settling damage cases to-day is vastly different from that of a few years ago. Street railroad systems are so extensive now that it is necessary for the management to have a claim department for the settling or fighting of damage cases. The secret of success in such cases lies no doubt in their being properly looked after from the start. The claim agent should ever be ready to answer a call. He should have the faculty of handling all sorts of people without friction. Evidence should be carefully secured in every case soon after the accident. Assistance and kindly tender of services after a serious accident are more in place than advances for settlement. Whenever possible, a sworn statement should be secured from the claimant, giving his history of the accident and stating as nearly as possible the damage done. In every case the claim agent should be fair, but firm. Too cheap a settlement is not always the best settlement, but one too expensive is perhaps worse. A full release of all claims should be taken from the claimant and its contents explained fully.

*Extracts from a paper read before the Convention of the American Street Railway Association, Niagara Falls, October, 1897.

The old saying that "an ounce of prevention is worth a pound of cure" was never better applied than to the accident features of a modern street railway system. There are several good devices for the prevention of accidents, among which the fender and the safety gate should be placed at the head. Experience has shown that the fender is seldom a nuisance, and is frequently of great value. The safety gate is a device intended to prevent passengers from getting on or off the car except when opened by the motorman. It is in use in St. Paul and Minneapolis, and was not generally approved upon its introduction, but has demonstrated its value by almost eliminating those accidents which occur through stepping on and off of moving cars. It also affords protection to people standing on the rear platform when the car rounds sudden curves. The gate is also of great service in handling large crowds at parks, where people lose their common sense. It also gives to the trainmen assurance in operating cars, which is of itself of considerable benefit.

The Discipline of Employees.*

BY GEORGE H DAVIS.

Discipline is universally recognized as a necessity in every important industrial undertaking. It is as thoroughly essential to success in the operation of railways as are the plans and specifications in their construction. A road has good discipline when all employees respect and kindly regard each other; when the officers do their best for the men, and vice versa. Discipline should never be interpreted in the narrow sense that a man is to work as a machine. There is no fixed method of maintaining good discipline. First of all, however, a railway manager should gain the implicit confidence of his officers and men. He must have a universal reputation among his men of being shrewd, vigilant, industrious, honest and perfectly fair in his dealings. He must be thoroughly popular and able to create among them a spirit of loyalty and enthusiasm for the road and its interests. Satisfactory discipline cannot be maintained unless the employees are worked to their full natural capacity and physical strength. Idleness and easy positions will undermine the best system of government that could be established. Again, constant watching is a most important factor. Nothing good or bad in a man's service should be passed without recognition. One of the strongest incentives to good work is praise. In general, a manager should have only praise for his officers, and among the men 90 per cent. should be above censure. Railway employees, as a rule, admire a policy that is open, fair and generous. When an unusually large day's work is done, it is no more than fair to share the profits with the men.

In all departments of the Canal & Claiborne Railroad, employees are placed upon a basis of competition. Men are chosen by a competitive examination and placed in the lowest rank. Promotions are made consecutively from one rank to another, and all higher positions are filled by promotions as far as possible. To be eligible for appointment as a motorman the applicant must be between the ages of twenty-five and forty years; must weigh between 160 and 210 pounds; must be at least 5 feet 8 inches in height, and must have had one year's experience. He should be recommended by at least three officers and also seven motormen and conductors already in the service. He must obtain a physician's certificate of his physical condition. His previous record is then looked into by an inspector, after which, if satisfactory, the man is placed on the lines. He rides with the older hands until familiar with the routes. He is then given a competitive examination. This consists of two parts; a practical test on the road and a list of questions covering his various duties. Finally the applicant presents himself at the office of the general manager, where he is questioned on his understanding of the conditions under which he is to work. After this, those having the highest standing are given positions as "extra" motormen and conductors, as fast as vacancies occur. Inexperienced men are required to work for three months without pay.

To determine the relative standing, a system of marking is used, which takes into account, first, the judgment of the various foremen on the man's work, and second, the special acts he performs. In the main office these records are reduced to arithmetical basis and carefully kept on the books. The "extra" motormen or conductors having the best record are promoted to "swing" runs. Similarly, the "swing" men to "half-and-half," and the "half-and-half" men to "straight-day" runs. The "straight-day" motormen are promoted to positions of inspectors, starters and transfer agents on their records alone. No account is taken of the relative date at which the employee entered the service.

It is evident that the bookkeeping necessary for such methods is more expensive than other forms of discipline generally employed. It has been found, however, that the expense is trifling compared with the results obtained. The larger the street railway, the more applicable are civil-service methods. This is due to the fact that on large railways the general officers cannot come in direct contact with employees to judge personally of their service. Where employees work on a competitive basis they invariably do their best. They feel that their present and future positions depend upon the quality of their work, and nothing else.

*Extracts from a paper read before the Convention of the American Street Railway Association, Niagara Falls, October, 1897.

Planing Rail Joints in Place.

In the city of Dresden, Germany, the street-car lines, formerly run by accumulators, are now being changed over to an underground-traction system. On these lines considerable trouble has been experienced with rail joints, as, whenever a rail end became depressed, the continual pounding rapidly made it worse, until it became unfit for service. A rather novel method of avoiding this was found by simply planing the surface of the rails flat across the joint. The work is done by two men sitting in the street, handling between them a scraping tool, with which they smooth the surface of the rail. The tool used for the purpose is simple, if nothing more. It consists of a number of square steel plates, the four edges of which are single beveled. Through the centre of each of these plates is a square hole by which a number of them are strung together on a square bar. They are fastened tightly together by clamps, and the whole is supplied with two handles. The result is a sort of compromise between a file, a planing tool and a milling cutter, with which very fair results are obtained by hand work. When one set of edges gets dull, the tool is turned over on its side, and another set used. When all four are dull, the plates are remounted on a mandrel shaped to hold them obliquely, so that their beveled edges lie in a plane. They are then ground up true on a stone.

A Long-Distance Test.

On October 11 a rather remarkable test was made with the plant of the Pioneer Electric Power Company, at Ogden, Utah. This plant has a transmission line from the power station in Ogden to Salt Lake City, which was described in THE ELECTRICAL WORLD of October 16. The test was made by joining the ends of the duplicate transmission lines at Salt Lake City and transmitting power from Ogden to Salt Lake City and back again, a total distance of 76 miles. To accomplish this the high pressure voltage was doubled, giving a pressure of 27,800 volts; 1300 electrical horsepower was sent over this line with a loss of only 3 per cent. The test was conducted by Mr. L. S. Boggs, the electrician in charge, under the direction of Mr. R. F. Hayward, the consulting engineer.

Meeting of the Ohio Electric Light Association.

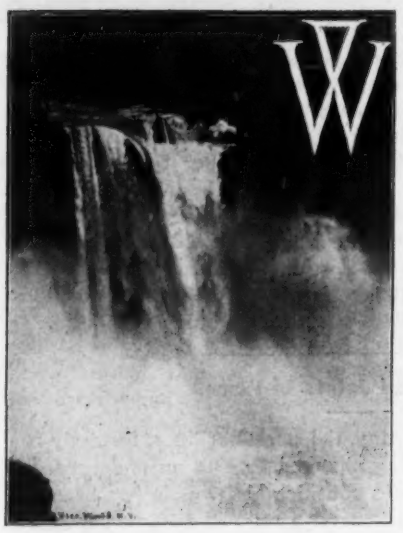
The annual convention of the Ohio Electric Light Associaiton took place at the Grand Hotel, Cincinnati, October 13 and 14. The sessions were much better attended than any previous meeting, and were of great interest to the members. Addresses were delivered by the president and by Hon. Forest E. Baker, of Massachusetts. After the business meetings the guests traveled to all points of interest in the city in a trolley party. The officers of the association are John J. Beggs, president, Cincinnati; George S. Long, vice-president, Troy; Samuel Scovil, secretary and treasurer, Cleveland.

Lord Kelvin's Return.

Lord and Lady Kelvin sailed for England on the Campania on Saturday, October 16. A farewell dinner was given the evening before by Dr. Robert Abbe, at his residence in New York City. The dinner was private, a number of prominent people and friends being present.

The Water Power Resources of the State of Washington.

BY ELEAZAR DARROW.



WHEN a survey of the undeveloped water powers in the State of Washington was first proposed by the Board of Regents of the Washington Agricultural College and School of Science, the magnitude of the undertaking was not appreciated. Financial conditions have limited the scope of the survey to a mere superficial examination, and it has only been possible for a start to be made in this work by the personal efforts of the president of the college and members of the Board of Regents. In the rapid development of mining properties and the scramble of prospectors of mineral claims, too little attention has been paid to the value of water powers. The limitations put on hydraulic mining in some of our sister States have caused many to overlook water properties. A few were farseeing enough to guard their rights, in the hope that they might be valuable for irrigation purposes. Few, indeed, have yet awakened to the fact that no more valuable properties can be owned in this State than a water property at a point where there is a demand for power transmitted and distributed by electrical means. The recent letting of a contract for the transmission of power 80 miles, and the installation of similar plants at Niagara and at St. Anthony Falls shows that extensive development along this line may be looked for.

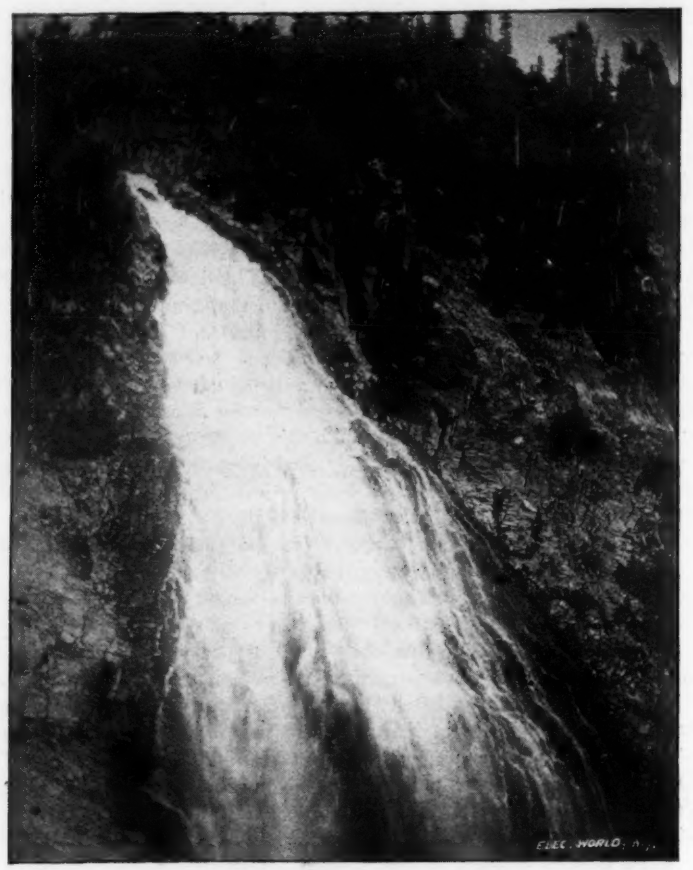
Spokane Falls.

The abundance of water power and its general distribution throughout the whole State is a surprising feature. The State boasts no Niagara, but in the multiplicity of water powers, averaging from 500 horse-power to 5000 horse-power, this State has no equal. Spokane Falls is probably the largest water power in the State, and has available a mean yearly output of not less than 150,000 horse-power, if properly developed. Lack of proper enterprise and engineering is apparent with such a magnificent power in the heart of a city of 40,000 people, two-thirds of whose work is done by steam. There should not be a steam plant in Spokane or its vicinity. Although Washington has considerable deposits of coal, the cost of transportation and the fact that the coal is not the highest grade makes a cheap fuel unavailable, and further enhances the value of water privileges.

The great watershed formed by the Cascade Mountains passes through the centre of the State from north to south, and the Rocky Mountains just touch the eastern border. Both of these ranges are filled with torrential streams, fed by mountain snows the year around. There are, indeed, few cities, towns or villages which are so remote from mountain streams that they cannot be supplied with cheap power, and power is so abundant that it cannot be monopolized and high prices maintained.

On the northeast boundary line between the States of Idaho and Washington are the beautiful Albani Falls, across which the Great Northern Railway's transcontinental line passes, offering to tourists a view at once surprising and grand. These falls are on the Pend d'Oreille River, 50 miles east of the city of Spokane. The river is the outlet of mountain lakes and has a nearly constant flow the year around. These falls have a plunge of 14 feet, and a flow by three channels of nearly 300,000 cubic feet per minute. An estimate shows that at least 5000 horse-power is available the year around. The river is navigable for 80 miles below, until it enters Box Canyon, where there is another fine power. Around the Albani Falls are some fifty prospectively paying mines. The Comstock is the largest shipper in the neighborhood. The nearness of this point to markets, its water power, minerals and timberlands, seem to make its future important.

The falls in the Spokane River, in the heart of Spokane City, furnish a matchless power. The total fall in one-fourth of a mile is 157 feet, which is separated into three plunges, the last being 60 feet high. Of the 150,000 horse-power available at this point less than



Sluiskan Falls, Mt. Tacoma.

10,000 horse-power is now utilized for electric light, power and milling purposes. There is tributary to the city a large grain-growing district, and Spokane should become a milling centre greater than Minneapolis, as the falls at Spokane exceed the water power at "Pillsburyville."

Eight railroads, three of which are transcontinental lines, centre at Spokane. Five miles above Spokane we find another fall of 20 feet, on the same river. Here the city has located its water works, and probably at some future time will have its own municipal lighting plant.

Other falls in the northeast part of the State, and available for development, are those in Kettle River, called Kettle Falls, also Meyers Falls and Big Falls. The latter are in the centre of the Box Canyon mining district. These powers are each capable of a development at their lowest stages of 3000 to 5000 horse-power. Countless torren-

tial streams have powers of lesser amounts, but it is without the scope of this article to detail them. Those interested in particular sections can secure information by addressing the secretary of the Board of Regents, State Agricultural College and School of Science, Pullman, Washington, under whose auspices the water power survey is being made.

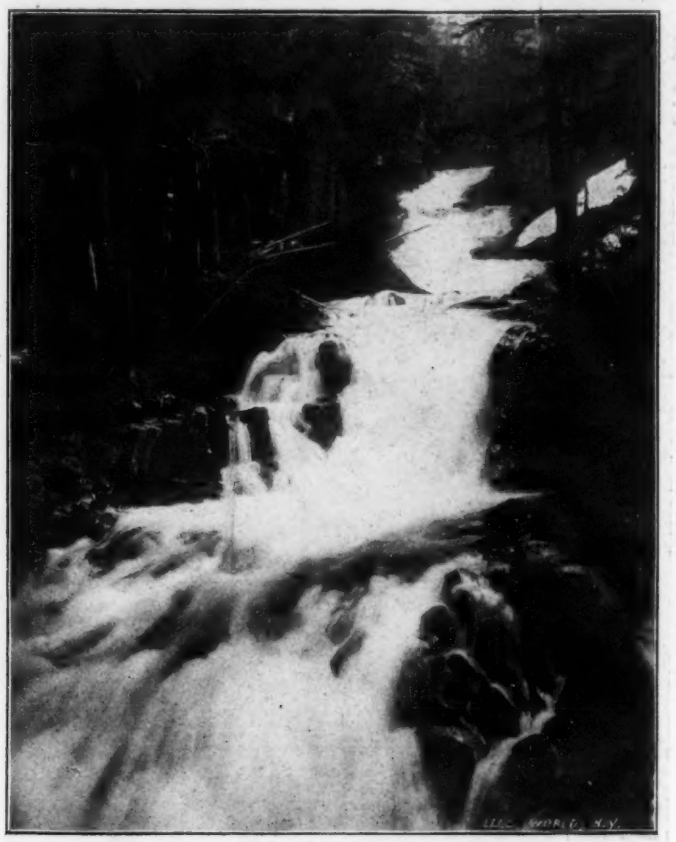
In the central portions of the State there is a great variation in the annual rainfall, but in those quarters where there is the least rain there is abundant water for irrigation purposes. Companies backed by large amounts of capital are now at work in the country east of the Cascades, reclaiming the sagebrush lands. In some localities canals and ditches 60 miles in length, and capable of carrying enormous amounts of water, are in process of construction. On these irrigated lands magnificent crops of grain and vegetables are grown, and as many as five crops of alfalfa are often cut in a single year. While many pumping stations have been built, much remains to be done in developing waterfalls in this section to further irrigation development.

Snoqualmie Falls.

The line of the Great Northern Railway going west leads to the Lake Chelan district. Lake Chelan is 70 miles long and 10 miles wide, and drains an area of 20,000 square miles. It is encircled by many rich mining camps. Vast deposits of coal, copper, silver and gold lie in the surrounding mountains. At the head of the lake we find the beautiful Rainbow Falls, 200 feet fall, in successive plunges. At the lower end of the lake we find the Chelan Falls. It is apparent that these powers are certain to be used largely in the treatment and reduction of the ores here found. At one reduction works in this Northwest country there were produced by a water-power electric plant during the past year 50,000,000 pounds of copper, 700,000 pounds of lead and 2,000,000 ounces of silver. The Chelan district offers the greatest possible opportunities for the electrical refining of ores. Minerals may be found in every mountain and hill. The whole eastern flank of the Cascade Mountains abounds in low-grade free-milling gold ore, and numerous veins, 200 to 500 feet thick, have been located in close proximity to water powers.

Three thousand mineral claims have been filed during the past eight months in Okanogan County alone, in the centre of which lie Lake Chelan and its falls. Across the Cascades, in the northwestern part of the State, is another district lavishly supplied with water powers. The chief industries here are mining and lumbering. The beautiful Skykomish River is a succession of falls, from each of which can be developed 200 to 500 horse-power, the water being used and used again, until it finally rushes into Puget Sound.

Twenty-five miles east of Seattle are the Snoqualmie Falls, the most beautiful and picturesque of all. In one vertical plunge of 268 feet they present an almost ideal power. On July 26, 1897, when the accompanying picture was taken, the water passing over the crest was at a lower stage than at any time in the past five years. On this date the flow was at the rate of 700 feet per minute, the water on the crest being 40 feet wide and 3 feet deep. It is evident that this would develop at least 35,000 horse-power with the minimum flow. Some years ago a plan was formed to develop and transmit to Seattle this power, but the stringency in the money market caused its temporary abandonment. Tacoma, although further from these falls, might receive a part of this power in these days of long-distance electrical transmission. But a smaller power is probably better available for Tacoma, viz., that of the Chambers Creek Power Company. Chambers Creek has a fall of 125 feet and a minimum flow of 80 cubic feet per second. The company has planned for an initial development of 1000-hp continuous service throughout the year. Tacoma power users have already spoken for this entire amount. One of the Tacoma street railway companies takes 300 horse-power. The total possible development of Chambers Creek will give a mean output of 2000 horse-power, and a maximum of 3000 horse-power.



Rainbow Falls, Lake Chelan.

Numerous water powers exist on Mount Tacoma, otherwise known as Mount Rainier, which lies 40 miles east of Tacoma. Probably one of the most available is the falls in the Sluisken River, from which 5000 horse-power could be developed at minimum flow.

A little farther to the south are the Nisqualli Falls, and also Linton Falls, each of which passes a considerable quantity of water. Linton Falls are nearly 300 feet in height.

In the extreme southeast part of the State is La Camas Lake, a beautiful sheet of water, 3 miles long, and 1½ to 2 miles wide. It is 40 to 90 feet deep, and 160 feet higher than the Columbia River, into which its outlet flows. This power is partially developed

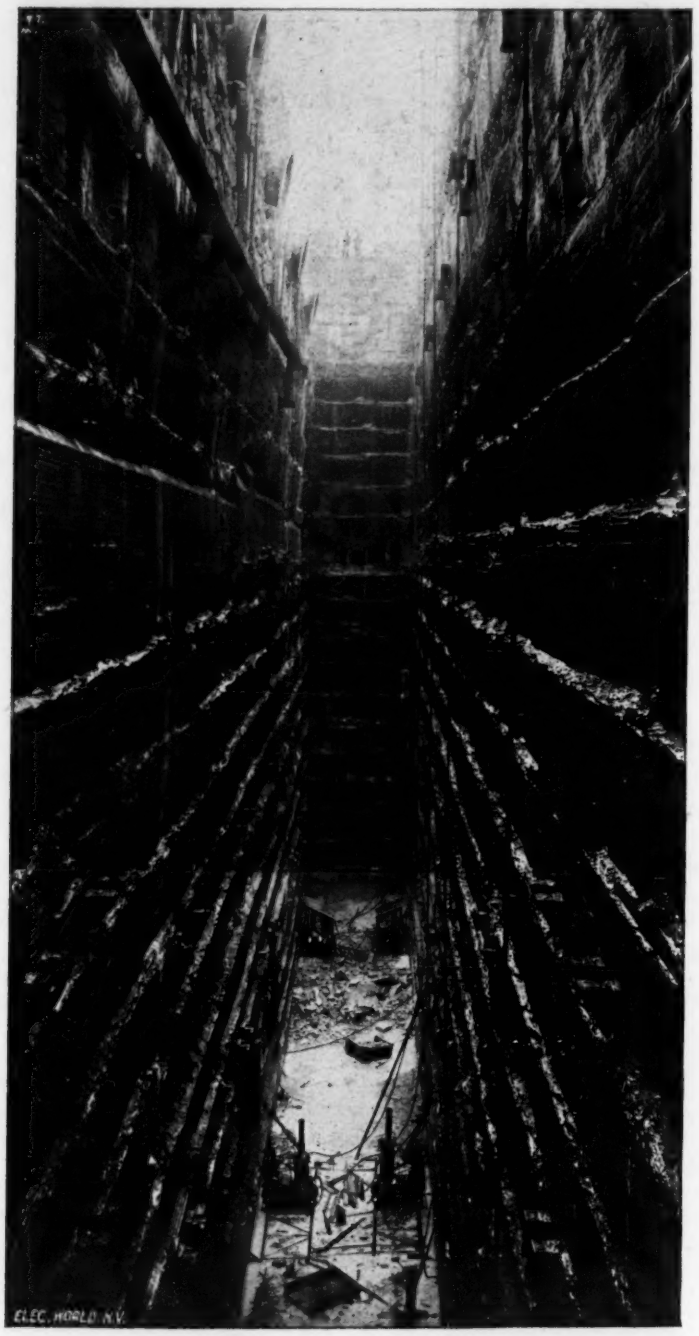
Another source of water power in Washington is the lake-like widening of rivers, at levels considerably above high tide, and yet lying within a short distance of Puget Sound. Examples of this are Lakes Union and Washington, near Seattle, their mean level being 20 feet above high tide. They extend to within 5000 feet of the sound. Lake Washington is 28 miles long, and from 1 to 5 in width, and drains an area of 300 square miles. Here, by laying less than a mile of flume, there may be obtained an enormous and inexhaustible power.

Another illustration is found at Lake Whatcom, which lies at an elevation of 318 feet above the sound and is immediately in the rear of the ports of Whatcom and Fairhaven.

The Extension of the Niagara Wheel Pit.

BY J. R. HASKIN.

During the first part of July, 1896, E. D. Smith & Co., of Philadelphia, commenced excavating the surface soil and loose rock in the rear of the Niagara Falls Power Company's station. The work thus commenced was the extension of the wheel pit under the power house—a long, narrow and deep slot, cut out of the solid rock, and designed to furnish room for the water wheels, penstocks, shafting and all the other hydraulic machinery required in the work of generating 20,000 horse-power. The first wheel pit was blasted out in the rough from the limestone bedrock, and the sides were



Extension of the Niagara Falls Power Company's Wheel Pit.

trimmed off roughly by hand, the result being uneven, rugged-looking walls, which, dripping with the moisture oozing slowly through the rock strata, remind one of a mining shaft.

The contrast between this first work and the walls of the newly-finished extension is very striking. E. D. Smith & Co., having undertaken the work, commenced operations with the most improved machinery. After having removed the loose surface earth and rock, channeling machines and drills were put in operation on the bedrock.

The channeling machine consists of a truck, traveling forward and back on a pair of 16-foot rails, and carrying a powerful drill. The whole machine is operated by one attendant, who, by working the truck slowly along the rails, and at the same time operating the drill, gradually cuts a slot in the rock along one side of the pit to the depth of about 6 feet. A corresponding slot having been cut on the opposite side also, the mass of rock between the two is loosened up by drilling and blasting, and removed to the surface. This method of procedure leaves a smooth, finished limestone wall, which looks very much like masonry. The appearance is rendered more so from the fact that the channeling machines cannot approach an opposing wall closer than 6 inches on account of projecting bolt-heads, etc. To allow for the shelves thus left at each level, the drill is inclined slightly from the vertical, so as to undermine the shelf. The resulting wall is vertical *in toto*, and apparently built up in courses of masonry.

All of the machinery used in the work of cutting this great slot in the ground was operated by compressed air, in order to do away with the clouds of steam that would have filled the pit. A 20 x 30-inch Rand duplex air compressor and three boilers were installed in a temporary shed near the end of the pit, furnishing compressed air at 60 pounds pressure. This was conveyed by a system of piping to various points where flexible hose could be coupled on and connected to the machines.

Owing to the cramped, space the work of channeling and blasting could not be pushed rapidly. Six machines working night and day were made to cut about 350 square feet. The removal of the broken-up rock was greatly facilitated by two 6-ton steam traveling cranes, which were mounted on a track running the length of the pit; 36,000 yards of rock to be removed means the expenditure of a vast amount of labor, and after reaching the surface it still had to be loaded on trains of flat cars and transported from 2 to 3 miles to the trestle work of the Junction Railway, where it was dumped and used for filling. It took 25,000 pounds of 40 per cent. dynamite to break up the rock.

As the work extended downward the penstock inlets were placed in position, and firmly imbedded in the upper walls of masonry. As the work progressed further down, stub ends, designed to support girders, which in turn support the shaft bearings, were imbedded in the walls. Finally, the bottom having been reached, a flooring of vitrified brick was laid, and brick walls built up on each side to the height of 30 feet. These walls are to support the girders, on which will be mounted the turbines. The space below is left to carry off the waste water, which will flow to the north end of the pit, thence to the tunnel.

The extension of the wheel pit just finished is 280 feet long, by 20 feet in width and 178 feet in depth, the whole length of the pit now being 458 feet.

When the work of the channeling machine and drills was finished, and the final blast fired, a start was made at once on the power-house extension. The steel framework, supplied by the Buffalo Structural Steel Works, was already on the ground, and it took but three weeks to get it set up. Since then masons and bricklayers have been hard at work on the side walls, and they are now well on the way to completion.

Excepting some minor details, the original plan of the work has been fully carried out, and many new features have been introduced; notably the excavation of three chambers in the east wall at the level of the turbine deck to furnish more room for compressors, pumps, etc. Three smaller penstocks have also been inserted between the mains, and they will furnish power to four-kw direct-current generators, which will be installed between No. 5 and No. 6 dynamos, in the form of a square. In the middle of this square will be placed an elevator, which will run as far down as the turbine deck.

This completion of the original plans gives space for ten units of 5000 horse-power each, and the remaining seven machines will be installed one at a time at intervals of several months.

The stone arch for the support of dynamo No. 4 is in the completed part of the station, and is nearly ready for the installation of the machinery. No. 4 dynamo is just completed, and is now being tested at the shops of the Westinghouse Electric & Manufacturing Company. It is hoped that it will be in operation before the year is finished, and that shortly afterward the new pit, which has been pushed through so rapidly, will be in use and paying interest on the great outlay necessary to construct it.

The sixteenth annual convention of the American Street Railway Association opened under most auspicious circumstances at Niagara Falls, on Tuesday, October 19. On all hands it was agreed that this convention was one of the most interesting and best attended in the history of the association. The exhibits were elaborate and complete, and of deep interest to the crowds of visitors who thronged the building.

TUESDAY, OCTOBER 19.

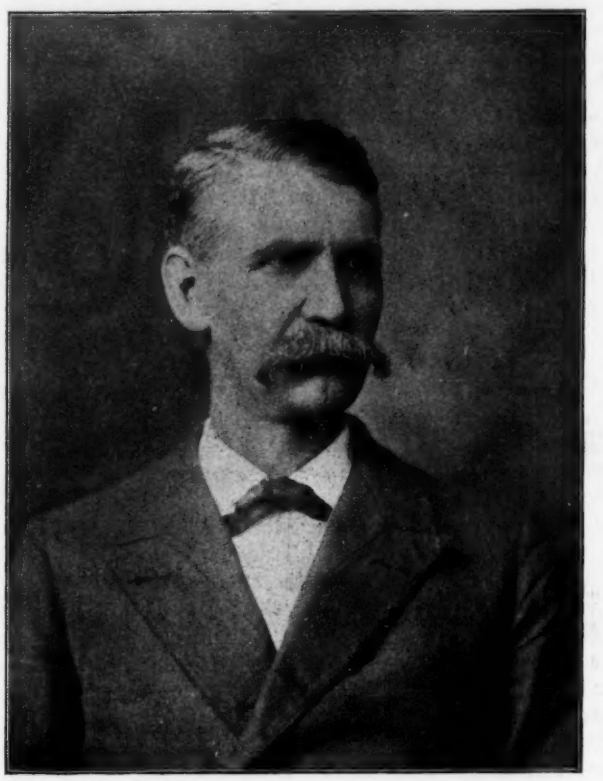
The opening session was called to order at 11:45 A. M. by President Robert McCulloch, who introduced Hon. A. C. Hastings, mayor of Niagara Falls. Mayor Hastings, in a short and graceful speech, welcomed the visiting members of the association to Niagara Falls. He spoke of the enormous power generated there, and briefly told the history of its development. In a few words he told how to best see the natural beauties of the place, and expressing his wishes for the growth and prosperity of the association, closed amid much enthusiasm.

After an acknowledgment by President McCulloch, Secretary T. C. Penington called the roll. Railway companies represented and not enrolled were requested to make application for membership, and it was stated that ten new memberships had already been received.

The minutes of last year's meeting were then approved, and President McCulloch made his address. He said:

GENTLEMEN OF THE AMERICAN STREET RAILWAY ASSOCIATION: Our convention assembly for the sixteenth annual period is within the sound of nature's greatest wonder, but the wonders that are wrought in own immediate application and appropriation of nature's resources are even more startling and awe-inspiring than the great Niagara cataract. If our ancestors of two centuries ago could sit in judgment on our doings of to-day we would unquestionably be required to involuntarily undertake the feat of the gallant Captain Webb, and if, perchance, we survived the perils of the raging torrent, the bonfires of our aboriginal predecessors would be rekindled on the cliffs below, and a fat frying would take the place of our discussions and merry making, as there could be no escape on our part from the charge of witchcraft. These great falls were worshipped by our red brother; the venturesome explorer and historian dipped his pen in consecrated fluid as he wrote reverentially of their grandeur; the poet and the maiden everywhere have sung of them in enchanting praise; reverence and poetry and romance have characterized the stories which tell us of them; but the matter-of-fact Yankee of to-day, casting reverence and poetry and romance to the winds, has harnessed them, like an old plowhorse, and compelled them, just as subserviently, to do his bidding; they make heat and light and power for all purposes; they revolutionize the processes of the manufacturer and the chemist, and ere we meet here again they will, without doubt, have been saddled with the menial duties of cooking and washing and tilling the soil of all the country around. The enabling element for the utilization of this wasted energy of the past is electricity, in the development and search for uses of which the scientist and manufacturer sleep not, neither do they rest. They furnish us with their best and latest devices and appliances to-day, and to-morrow these devices and appliances are obsolete. To keep our place in the procession we must join in the cry of "The king is dead; long live the king." We must discard the old and adopt the new, or else be ground under the wheels of this juggernaut of progress. Unfortunately, if we endeavor to "shun Scylla, we are in danger of being wrecked on Charybdis;" hence we assemble here to counsel together as to how we may best shape our course. To learn more of this revolutionary factor in our business, to discuss this and other kindred subjects, to compare our experiences, to meet and greet each other, to renew old friendships and acquaintance, and to form new ties, to be forced, if need be, to recognize that "there are other pebbles," to find that the American Street Railway Association is filled with men to know whom is both an honor and a pleasure—these, my friends, are some of the things which have brought us together, and it is hoped that a full measure of pleasure and profit will reward all who honor us with their presence.

Our local brethren, with a hospitality as abounding and exhaustless as the never-ceasing flow of their great river, have provided



PRESIDENT ROBERT MCCULLOCH.

for our physical comfort and entertainment. We beseech them not to seduce us from a proper contemplation of the business before us.

Our nobly ally, our helper in all the good work we accomplish, our always alert, jovial and genial friend, the supply man, has contributed, as usual, his share to our entertainment and enlightenment. He is here to show us the best of everything he has. He is not, in one sense, a member of our association; he does not participate in our deliberation; but he stands at our threshold, and the vigilance which he exercises, that none may escape, is worthy of our emulation in the conduct of our business. Let us show our appreciation of his efforts by inspecting his wares, by loading him with orders and by fraternizing with him, that his enjoyment of the occasion may be equal with ours.

We have still another and a new element in our gathering for this year. While we are here engaged in the discussion of questions pertaining to the construction, equipment and operation of the roads and interests in our keeping, there is assembled near by, and also in deliberate convention, an earnest, intelligent, enthusiastic body of mostly younger men than ourselves. They have in

view the same objects which bring us together—a betterment in the performance of street-railway work. Their duties, while distinct and apart from ours, are just as essential, and the requirement is for the same degree of intelligence, industry and integrity. Their organization is young, and they are just starting out in their efforts to enlighten each other by a mutual interchange of information as to methods and ways. I allude to the Street Railway Accountants' Association. Let us not extend to them the right hand, but both hands, and help and encourage them to persevere in their good work. Their interest and efficiency in the performance of their duties is susceptible of the same betterment by convention as ours. If they find it desirable and convenient to meet at the same time with ourselves, and thus extend the acquaintance and good fellowship between the operating and accounting departments which must result from contact let that arrangement continue; but if it be considered wiser to have two separate meeting times and places, that may be the plan, but they should have our encouragement and indorsement, and even financial support, if necessary.

Our meetings are always attended by quite a number of persons engaged in the same business as ourselves, but whose companies are not members of the association, and we receive requests for information from the same source, which information is always cheerfully given. We would not like to close our doors against these non-members, but we would be glad to enter their names in our official lists, and their annual dues, which is only a small amount, would fill an aching void in our treasury.

There is still another class, who, although members of our association, seldom or never grace our meetings with their presence. Whether this may be from a lack of time, a feeling of exclusiveness or a consciousness of a possession of all the knowledge attainable concerning our business, I know not. But if the first, an effort and sacrifice might be made experimentally; if the second is the cause of their absence, a surprise and discovery is in store for them if they will only develop it. And if the last reason keeps them away, a feeling of charity and good will for their fellow laborers should impel them to come among us, and show us how to surmount our perplexing obstacle.

The questions to be discussed in our convention have been selected with reference to newer developments and applications. The gentlemen honored by selection (and the honor should be much coveted) to prepare papers have all been urged to be present and personally present their efforts, thus giving them a force that can only be imparted by the enthusiasm of the author. Time will be given for the presentation and discussion of each paper, and it is hoped that discussions will be free and exhaustive.

I wish that my successor in office may have a secretary and executive committee who so thoroughly realize and faithfully perform their duties as have the secretary and executive committee who have assisted me in the performance of my very pleasant work.

And now, my friends and brethren, thanking you with more earnestness than my language can express for the unexpected honor with which you crowned me a year ago, and promising an impartial ruling on all questions presented, we will proceed with the business of the convention.

The report of the executive committee consisted of the minutes of two meetings. The list of members who have died during the past year was read, and a committee appointed to prepare suitable resolutions.

After Secretary and Treasurer T. C. Penington had made his report a number of letters of regret from absent members were read.

A resolution was then unanimously adopted approving the organization of the Street Railway Accountants' Association of America.

The first paper on the programme was entitled "Municipal Ownership of Street Railways," and was presented by Mr. P. F. Sullivan, general manager of the Lowell & Suburban Railway Company, of Lowell, Mass. The paper, of which an abstract appears in another column, was read by Secretary Penington, and was succeeded by a short discussion.

Mr. G. W. Knox, electrical engineer of the Chicago City Railway Company, presented a paper on "Some of the Difficulties Existing in the Construction and Operation of Electric Street Railways," of which an abstract is given elsewhere in this issue. A short general discussion ended the session, an adjournment being taken until Wednesday morning at 9:30.

At 2:30 P. M. a visit was made to the power house of the Niagara Falls Power & Manufacturing Company, after which through the courtesy of the Niagara Falls & Suspension Bridge Railroad Company, which placed its cars at the disposal of the convention, the party proceeded to the power house of the Niagara Falls Power Company and the factories of the Carborundum Company and the Niagara Falls Paper Company. The delegation visiting these points of interests is said to have been the largest in their history.

In the evening the ladies of the local reception and entertainment committee held an informal reception in the parlors of the International Hotel, during which a most enjoyable entertainment was rendered by several local musicians of prominence.

WEDNESDAY, OCTOBER 20.

The session was convened by the president at 10:45 A. M., and after the reception of the auditing committee's report and the reading of notices proceeded at once to the reading of papers. The first on the list was read by its author, Mr. Charles Hewett, electrical engineer of the Union Traction Company, of Philadelphia, its title being "The Application of the Storage Battery to Electric Traction." A full abstract of this paper appears in another column of this issue. The discussion was opened by Mr. J. A. McCormack, who inquired of Mr. Hewett in what two cities the conditions rendering storage-battery traction by batteries on the cars feasible, existed. Mr. Hewett said that Washington and New York alone, in his opinion, presented the requisite combination of public opinion and physical configuration. Mr. W. W. Bean said that the less æsthetic inhabitants of other towns found themselves able to get along with the trolley. Mr. Mac Faden inquired if the use of boosters alone or in connection with storage batteries was most desirable. In his reply, Mr. Hewett said that he fully believed that all small stations would be benefited by the installation of accumulators; that the fair proportion of average to maximum load was generally as 2 to 3, and that, hence, the battery would reduce the cost of power generation, and by steadying the load, enable the steam machinery to be worked at a far more efficient point than was usually the case.

In response to a query by Mr. W. E. Harrington, he said that in the case of the Chestnut Hill plant referred to in his paper the manufacturers had agreed to guarantee the maintenance of the cells for a term of ten years at a certain percentage of their cost price.

Mr. Patterson, of Salt Lake City, related the experience of his company, which is operated by a water plant, situated 18 miles from the city, and employing an alternating-current system of transmission. He said that it had been found necessary to maintain in good order the steam plant in the city formerly used, in order to guard against interruption of the service by accidents. Already a snow slide had destroyed some of the hydraulic works at the generating station, and in such cases it had taken two or three hours to get the steam up and start the cars. He wished to know the advisability of installing an accumulator to tide over the time necessary to start the city station in case of such an accident. In his reply, Mr. Hewett stated that, in such cases, the determining factor would be cost alone.

Mr. Mac Faden here again raised the point of the relative desirability of boosters, alone or used in connection with accumulators. Replying, Mr. Hewett said that the battery was desirable in connection with any long feeder where a sudden release of the load might cause a dangerous rise in the voltage. He cited one case in his company's system where a booster pressure of 250 volts was added to the 550 volts at the bus bars. In such cases the terminal voltage on open circuit might rise to 800 volts if no battery were used, thus endangering controllers and destroying lamp circuits.

Mr. Munyon inquired about application of batteries where there were occasional heavy overloads and massing of cars, as in the case of lines to race-tracks, baseball grounds, etc., and wished to know the feasibility of equipping a car, or several of them, with batteries, and sending these to the end of the line as a preparation for such overlods. To this Mr. Hewett said that he could give no estimates of the cost, and hence of the utility of such a method, without preparation, but that the scheme was familiar to those in use in certain cities in Europe.

A short discussion followed a motion by Mr. H. M. Littell, that representatives of manufacturers of accumulators present be allowed to speak, and resulted in its defeat.

Mr. Wilson, of Sioux City, said that during the past two years a number of small plants having output capacities of less than 1000 kilowatts had been installed with direct-coupled units. These have a small range of efficient running, and generally the engines were too lightly loaded. He asked for information as to the effect of accumulators installed in such station for load regulation. Mr. Hewett said that in the case of Easton, Pa., four engines had been required to operate the railway before the installation of an accumulator, but that since then three had done the work, all running at much higher economy. He thought the saving amounted to as much as 25 per cent., or, taking the loss in the battery into account, about 20 per cent.

Mr. W. C. Ely said that he thought the accumulator question was the most important one before the convention. He cited the case of railways in Buffalo buying 24 horse-power from Niagara at a fixed annual charge, and using little or none of it during long periods of the day. In this case he thought that the installation of a battery would effect a considerable reduction in the amount of power necessary to be contracted for. Mr. Hewett closed the discussion with a few remarks upon the stability and reliability of accumulators, which he declared to be entirely serviceable and satisfactory. In most cases failures had been due to the installation of accumulators too small for the work demanded of them.

Col. D. B. Dyer moved a vote of thanks to Mr. Hewett, which was enthusiastically given.

The next paper, on "Power Distribution and the Use of Multiphase Current Transmission for Ordinary Street Railways," by Maurice Hoopes, electrical engineer of the Lynn & Boston Railway Company, was read by Secretary Penington, Mr. Hoopes being unable to attend the convention on account of illness. The paper is reprinted in this number of THE ELECTRICAL WORLD.

At 2:30 P. M. a group photograph of the delegates and visitors was taken at the entrance to the upper Suspension Bridge. By courtesy of the Niagara Falls Park & River Railroad Company, the Niagara Falls Navigation Company and the Great Gorge Route, a large party of the delegates were taken over the gorge road trip, which was greatly enjoyed, despite dark weather and rain. In the evening a musicale and hop were given in the parlors of the International. The ladies' entertainment committee gave the visiting ladies a carriage drive about the points of interest and a trip on "The Maid of the Mist" during the forenoon.

THURSDAY, OCTOBER 21.

The convention was called to order at 11 o'clock by the president, and the report of the committee on rules and regulations for the government of employees asked for. This not being ready, an amendment to the by-laws was passed after some discussion, giving the executive committee authority to set the date of each meeting at any time between September 15 and January 1 that they might determine upon. This was rendered necessary by the uncertainty of October weather in some latitudes, the dismal skies of Niagara probably having much influence in the matter.

Mr. Dimock, president of the Omaha & Council Bluffs Railway, asked for a discussion of ways and means for increasing the remuneration received by those railways engaged in carrying mails for the United States Government. A short discussion, in which several delegates participated, resulted in the passage of a resolution requesting the incoming executive committee to make this matter the subject of one of the papers for the next meeting.

During the discussion a delegation from the Street Railway Accountants Association, then in session in another part of the building, was announced, and its chairman, Mr. Duffy, vice-president of that association, requested to address the convention. He said that he bore the thanks of his association for the recognition that had been given it, and briefly explained its object. After an exchange of complimentary remarks, the delegation withdrew and the regular order of proceedings was continued by the reading of a paper by Mr. George H. Davis, superintendent of the Canal & Claiborne Railroad Company, of New Orleans, on "The Discipline of Employees." The usual vote of thanks was tendered Mr. Davis for his paper, which recived marked attention. It is abstracted in another part of this issue.

The report of the committee on rules for the government of Employees was then read, and the committee continued in office for another year, with instructions to formulate and present a set of rules.

"The Application of Electricity to Railroads Now Operated by Steam Power" formed the title of the next paper, which was read by its author, Col. N. H. Heft, president of the Meriden Street Railway Company. This subject, being that most prominent in the field of railway engineering at present, proved of deep interest to the delegates present, but was not fully discussed, on account of the amount of business before the session and the lateness of the hour. In reply to a question for further data, Colonel Heft said that the railway company made no secret of the data obtained and would cheerfully furnish them to those who should apply. He stated, in response to another inquiry, that the relative cost of the third-rail system at New Britain, including all the track-bonding, and the overhead system with copper conductors at Nantasket, was about as 1 to 2, the third-rail system having cost about $3000 per mile in place.

Mr. W. J. Hield, of the Twin City Rapid Transit Company, Minneapolis, read an interesting paper on "The Best Method of Settling Damage Cases and Prevention of Accidents by the Use of Fenders or Otherwise."

PRESIDENT-ELECT A. E. LANG.

The committee on nominations and the choice of a place of meeting for the next convention was then called for, but was delayed by a vigorous discussion of the propriety of printing the papers to be read at each convention in advance of the meeting. The vote showed an overwhelming preference for the present method of keeping the papers in abeyance until actually read at the meeting.

The nominations were then received as follows: For president, A. E. Lang, of Toledo, Ohio; first vice-president, W. C. Ely, of Niagara Falls, N. Y.; second vice-president, John A. Rigg, Reading, Pa.; third vice-president, Edward T. Connett, Nashville, Tenn.; secretary and treasurer, Thomas C. Penington, Chicago. For the executive committee the following gentlemen were named: Robert McCulloh, St. Louis; C. D. Wyman, New Orleans; H. C. Moore, Trenton, N. J.; John Roach, Chicago, and Robert S. Gott, Fall River, Mass. The place of meeting selected is Boston.

The announcement of the nominations and the selection of Boston were received with cheers, and the formal election of the officers and committee as nominated being finished the session adjourned.

During the forenoon the visiting ladies had been entertained by the ladies and gentlemen of the local reception committee by a trip to Youngstown and Fort Niagara.

In the evening the annual dinner was held at the International Hotel, followed by a ball, which lasted well into the small hours.

President-Elect A. E. Lang.

Albion Earl Lang, the newly elected president of the American Street Railway Association, was born at Huntington, Ohio, in 1849. His boyhood was spent in Wellington, in the same State. Since 1871 Mr. Lang has been interested in the street-railway business. In that year he obtained control of a small horse railroad in Toledo, Ohio, there being at that time five or six such roads in operation there. They are all now consolidated and all operated by electricity, the Toledo Traction Company, of which Mr. Lang is president, being the title of the consolidated corporation. It operates 120 miles of track and about 200 cars. The plant was designed by Mr. Frederick Sargent, the electrical engineer of the World's Fair.

The station of the Toledo Traction Company is operated in connection with that of the Toledo Consolidated Electric Company, of which Mr. Lang is also president.

The new executive of the association is an active man of affairs, and personally manages the business of the corporations of which he is president. He has been a member of the association for ten years. An amusing fact is that at the first meeting he attended, only ten years ago, much objection was made to the discussion of electrical subjects, on account of the waste of time entailed. Three years later, Mr. Lang says, the horse was mentioned for the last time at a convention.

Convention Notes.

E. P. SHARP, Buffalo, exhibited a lot of second-hand street-railway apparatus.

THE LACLEDE CAR COMPANY, St. Louis, was represented by Mr. I. E. Robinson.

THE MILWAUKEE RAIL JOINT COMPANY exhibited the Austin patent rail joint.

THE BROWNELL CAR COMPANY, St. Louis, was represented by Mr. F. B. Brownell.

MR. F. H. NEWCOMB, of New York, was present with handsome samples of uniform caps, etc.

THE BRADFORD BELTING COMPANY, Cincinnati, was represented by Mr. O. M. Hubbard.

THE AMERICAN ELECTRICAL WORKS, Providence, was represented by Mr. P. C. Ackerman.

MESSRS. O. R. SACKETT & CO., Niagara Falls, showed an ingenious automatic trolley catcher.

"KERITE," W. R. Brixey, New York, was kept before the convention by Mr. George F. Porter.

FAIRBANKS, MORSE & Co., Chicago, had on exhibition the Barrett lifting jack in various sizes.

MESSRS. BRADT & ZIMMERMAN, Troy, N. Y., exhibited a new form of handle latch for car doors.

FRED. M. LOCKE, Victor, N. Y., showed a collection of high-tension insulators in porcelain and glass.

THE AMERICAN PULLEY COMPANY, Philadelphia, exhibited some well-built all-steel split pulleys.

THE E. T. BURROWES COMPANY, Portland, Me., had a tasteful exhibit of car shades and curtains.

CAMBRIA IRON COMPANY, Johnstown, Pa., exhibited girder and guard rails, steel T-rails and fastenings.

THE G. C. KUHLMAN COMPANY, Cleveland, was on hand with a very handsome specimen of its type of car.

THE SCHLICHTER CORDAGE COMPANY, Philadelphia, was represented by the energetic Mr. A. V. Dee.

THE SAFETY INSULATED WIRE & CABLE COMPANY, New York, was represented by Mr. H. T. Richards.

THE TROJAN BUTTON FASTENER COMPANY, of Troy, N. Y., exhibited the Ham sand box for motor cars.

THE CHICAGO INSULATED WIRE COMPANY, Chicago, had present Mr. William M. Smith as its representative.

RUBBER RAILWAY JOINT MANUFACTURING COMPANY, of New York, showed its various forms of rail joints.

SAMUEL L. GLOVER was an interested visitor, and represented the Post-Glover Electric Company, of Cincinnati.

THE BUDA FOUNDRY & MANUFACTURING COMPANY, Harvey, Ill., exhibited the Paulus track drill for manual operation.

MR. RUSSELL T. WALKER, of New York, looked after the interests of the Heine Safety Boiler Company, of St. Louis.

AMERICAN RAIL JOINT & MANUFACTURING COMPANY, Cleveland, showed samples of its various forms of rail joints.

MR. D. J. SINCLAIR, Caledonia, N. Y., exhibited an automatic coupling for street cars, also a flexible coupling for traction engines.

THE HEMINGRAY GLASS COMPANY, Covington, Ky., showed numerous styles of glass insulators, its exhibit being in charge of Mr. D. C. Hemingray.

THE JOYCE-CRIDLAND COMPANY, of Dayton, Ohio, represented by Mr. J. O. Joyce, showed a number of lever and screw jacks.

THE LEONHARDT WAGON MANUFACTURING COMPANY, Baltimore, showed its latest form of emergency and tower wagons.

MESSRS. L. A. CHASE & CO., Boston, whose circuit breakers and fuses are so extensively used, were represented by Mr. S. B. Condit.

MESSRS. L. A. SAYRE & CO., Newark, N. J., exhibited ticket punches and a new pad punch. Mr. L. A. Sayre was the representative.

THE AMERICAN CAR COMPANY, St. Louis, had its interests well taken care of by Mr. E. J. Lawless, its New York representative.

THE PEARSON JACK COMPANY was represented by Mr. George M. Brown, and exhibited its latest improved form of replacing jack.

MR. W. M. HABIRSHAW, of the India Rubber & Gutta Percha Insulating Company, New York, was an interested visitor at the convention.

A. O. NORTON, Boston, through Mr. H. A. Norton and Mr. E. T. Trefethen, exhibited his ball-bearing lifting and shore-drop track jack.

THE CORNING BRAKE SHOE COMPANY, of Buffalo, exhibited brake shoes adapted to nearly every variety of wheels that run upon rails.

THE NEW YORK CAR WHEEL WORKS, Buffalo, furnished an exhibit of car wheels and cold-rolled axles. Mr. J. A. Granger was in charge.

THE NEAL HEADLIGHT COMPANY, Boston, was represented by Mr. George C. Ewing, the secretary of the company, and Mr. F. E. Huntress.

E. F. DEWITT & CO., of Lansingburgh, N. Y., exhibited the DeWitt common-sense sandbox, Mr. E. F. DeWitt being on hand to explain its merits.

THE VAN WAGONER & WILLIAMS HARDWARE COMPANY, of Cleveland, exhibited a handsome collection of drop-forged commutator bars.

THE FUEL ECONOMIZER COMPANY, of Matteawan, N. Y., had on exhibition specimens of their vertical cast tubes and a model of an economizer.

THE MILLER-KNOBLOCK COMPANY, of South Bend, Ind., exhibited a line of assembled commutators for all standard types of street railway motors.

THE DILWORTH & PORTER COMPANY, Pittsburg, displayed an assortment of rail spikes and tie plates, and was represented by Mr. E. L. Maxwell.

MICHIGAN ELECTRIC COMPANY, Detroit, Mich., was represented by Mr. J. E. Lockwood, one of the best known members of the electrical fraternity.

MR. FRANK MAC GOVERN, New York, was in attendance on behalf of his firm, Rossiter, MacGovern & Co., New York, and made many new friends.

THE PITTSBURG REDUCTION COMPANY, of Niagara Falls, placed on exhibition a number of ingots of pure aluminum, which were greatly admired.

THE MEHLING MANUFACTURING COMPANY, Cleveland, Ohio, had on exhibition its system of portable car safes and registers and metal car tickets.

DAYTON AUTOMATIC CAR SWITCH COMPANY, Dayton, Ohio, displayed its automatic car-track switch. Mr. Franklin Rice represented the company.

MR. FRANK HARRINGTON, of the India Rubber & Gutta Percha Insulating Company, was present on behalf of his company, and did some very effective work.

SPRINGFIELD MANUFACTURING COMPANY, Bridgeport, Conn., showed standard machines for grinding car wheels. Mr. G. W. Jackman was in charge of the exhibit.

THE SOLAR CARBON & MANUFACTURING COMPANY, Pittsburg, had its interests well looked after by Mr. F. M. Laughlin, who made many friends at the convention.

MR. E. D. WARNER represented the Parrish Signal Company, of Jackson, Mich., manufacturers of an ingenious electric signal, giving audible and visual signals at crossings.

THE WASHINGTON CARBON COMPANY, Pittsburg, was represented by Mr. J. S. Crider. This company does considerable business in the line of motor and generator brushes.

POMEROY & FISHER, New York, through Mr. Joseph Pomeroy, had quite a noticeable collection of samples of the various varnishes, oils and colors manufactured by the firm.

MR. CHARLES F. AGARD, master car builder of the Hartford Street Railway Company, Hartford, Conn., showed an ingenious swiveling device for hanging vestibule doors in cars.

THE MONARCH STOVE AND MANUFACTURING COMPANY exhibited two full-sized models of its track cleaner. Messrs. W. T. Hurst and E. C. Baxter had charge of the exhibit.

ADAM COOK'S SONS, New York, whose Albany lubricating compounds are extensively used by electric street-railway companies, were represented at the convention by Mr. J. Hernandez.

MR. D. C. SWEET, of Springfield, Mass., explained in person the operation of his car-wheel grinder, an ingenious portable device for truing wheels without disturbing the car mechanism.

THE CHARLES SCOTT SPRING COMPANY, Philadelphia, was ably represented at its handsome exhibit of every kind and size of springs by Messrs. H. C. Johnson and D. S. Roche.

WILLIAM WHARTON, JR., & CO., INCORPORATED, of Philadelphia, had an interesting exhibit of their switches, crossings, frogs, tongues and other heavy rail specialties in a corner of the hall.

THE McMULLEN WOVEN WIRE FENCE COMPANY, Chicago, exhibited specimens of fence construction, and Mr. E. G. Fisher, manager of the railway department, was on hand to explain the advantages of his company's goods.

THE WALKER COMPANY'S EXHIBIT.

THE NEW HAVEN CAR REGISTER CO.
NEW HAVEN, CONN.
THE FAMOUS "NEW HAVEN" FARE REGISTERS
THE FAMOUS "NEW HAVEN" FARE REGISTERS.
Our Latest - A Double Register for two Connecting Railways
COMPLETE IN EVERY DETAIL.

THE NEW HAVEN CAR REGISTER COMPANIES' EXHIBIT.

JOS. DIXON CRUCIBLE CO. JERSEY CITY N.J.
GRAPHITED WOOD GEAR GREASE.
PREVENTS NOISY GEARS
GRAPHITED SWITCH & CURVE GREASE.
DIXONS Silica Graphited Paint
for Trucks, Roofs and Smoke Stacks.
H.W. JOHNS MFG CO.
INSULATING MATERIALS. ELECTRIC HEATERS.

H. W. JOHNS AND DIXON CRUCIBLE COMPANY'S EXHIBITS.

THE HOPE ELECTRIC APPLIANCE COMPANY, Providence, had on exhibition its instantaneous make-and-break safety switches, the merits of which were explained by Mr. John I. Drake.

THE CREAGHEAD ENGINEERING COMPANY, of Cincinnati, had a fine exhibit of electric-railway supplies and line material, which was shown under the supervision of Mr. G. R. Scrugham.

MESSRS. J. H. BUNNELL & CO., New York, one of the oldest firms in the electrical-supply business, was represented by Mr. John J. Ghegan, who has long been a familiar figure at conventions.

THE ADAMS & WESTLAKE COMPANY, of New York and Chicago, showed a fine collection of car lamps and incandescent-light fixtures, as well as a general line of car fittings and brass goods.

DETROIT STOVE WORKS, Detroit, exhibited the Jewel street-car heater, having a number of handsomely finished heaters, which attracted much attention. Mr. H. L. Shutt represented the company.

RUSSELL MANUFACTURING COMPANY, Chicago, showed its curve-taking trolley harp and crossing taker for preventing the losing of the trolley. The company was represented by Mr. W. H. Russell.

THE MEAKER MANUFACTURING COMPANY, Chicago, showed its various styles of car registers. Mr. J. W. Meaker was on hand to furnish information to callers concerning his well-known register.

The Steel Motor Company's Exhibit.

KLEANIT, made by the Kleanit Company, Akron, Ohio, is a compound which Mr. W. F. Dressler, having charge of its exhibit, declared would brighten anything. He secured some excellent orders.

THE BUDA FOUNDRY & MANUFACTURING COMPANY, Harvey, Ill., exhibited the Paulus track drill, and also showed a drill for T-rail and 11-inch girders. Mr. Charles Parsons represented the company.

THE JANDUS ELECTRIC COMPANY, of Cleveland, Ohio, and the Buckeye Electric Company, of the same city, were ably represented by Mr. Bailey Whipple, who was in charge of exhibits for both.

CLEVELAND FROG & CROSSING COMPANY had on exhibition steel centre frogs, cast-steel frogs, various forms of switches and the derailing Porter switch. The company was represented by Mr. A. Powell.

MESSRS. NAUGLE, HOLCOMB & CO., Chicago, electric-railway contractors, who have done much thorough and satisfactory work in electric-railway construction, were represented by Mr. E. E. Naugle.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, was represented by Mr. A. C Garrison, who reported that the sales of the Columbia lamp among street-railway companies was rapidly increasing.

COLUMBIA MACHINE WORKS, Brooklyn, exhibited a line of electric-railway supplies, embracing a number of specialties of particular interest to street-railway men, and was represented by Mr. W. R. Kerschner.

THE CUTTER ELECTRIC & MANUFACTURING COMPANY, of Philadelphia, showed a fine collection of I-T-E circuit breakers, among them being the smallest and largest of such instruments ever constructed.

THE BIBBER-WHITE COMPANY, Boston, Mass., was represented by Mr. C. E. Bibber, who, beside circulating among the delegates, distributed a neat little souvenir in the shape of a letter opener and pocket comb.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Newark, N. J., was conspicuous in many parts of the exhibition building, few switchboard equipments being without some form of instrument of the Weston make.

THE NEW PROCESS RAWHIDE COMPANY, Syracuse, N. Y., whose rawhide gears and pinions are so well and favorably known to street-railway managers, was represented by Mr. T. W. Meacham and Mr. A. C. Vosburgh.

MESSRS. PRATT & LETCHWORTH, Buffalo, exhibited malleable iron and open-hearth steel castings for electric and railway work. This company's specialty is castings for manufacturers. Mr. C. R. Brown represented the firm.

THE JEWELL BELTING COMPANY, Hartford, Conn., was well represented by Mr. C. L. Tolles, with the assistance of Mr. A E. Silk, who presented a handsome leather cigar case to those who had use for such an article.

FORSYTH BROTHERS & CO., Chicago, exhibited various styles of car curtains, curtain fixtures, and showed section of cars, illustrating the application of the goods. Mr. W. H. Forsyth and Mr. G. H. Forsyth were present.

THE KAUFFMAN-CONKELL COMPANY, of Canton, Ohio, showed an ingenious trolley-wire cut-out, operated by a break in the line. Messrs. L. A. Loichor and W. J. Kauffman explained the cut-out to many interested visitors.

JONES & LAUGHLIN, Pittsburg, made a nice display of cold-rolled car axles, the merits of which were explained by Mr. B. R. Gerry, who also distributed a souvenir, a little book of useful information for mechanics and engineers.

THE D. & W. FUSE COMPANY, Providence, attracted much attention by its fuse tests and excellent samples of fuses and appliances for street-railway work. Mr. L. W. Downes and Mr. A. W. Hutchins were the representatives.

MESSRS. J. C. DOLPH & CO., New York, made an exhibit of the various specialties for which they are the agents, roll-drop and drop-forged bars, rail bonds, insulating varnish, brake handles, sand boxes, being among the goods shown.

THE STERLING SUPPLY & MANUFACTURING COMPANY, New York, displayed its various specialties in the shape of registers, sand boxes, safety brakes and insulating material, through its able representative, Mr. F. A. Morrell.

CENTRAL UNION BRASS COMPANY made an exhibit of its various electric and railway supplies, and Mr. T. C. White, the manager of the company, distributed a handsome little souvenir in the form of a commutator, which was very popular.

MR. CHARLES Y. FLANDERS, New York, represented Messrs. Morris Tasker & Co., of Philadelphia, and the National Water Tube Boiler Company, of New Brunswick, N. J., and distributed a novelty souvenir in the form of a transparent purse.

INTERNATIONAL REGISTER COMPANY, Chicago, had a nice display of its registers. Messrs. A. H. Woodward, W. H. Brown and C. N. Wood were kept busy explaining the merits of the International Register, but did not appear to tire of it.

TAUNTON LOCOMOTIVE WORKS, Taunton, Mass., had on exhibition two large snow plows. Mr. Joseph Wendell, of Wendell & McDuffie, New York, agents for the Taunton Locomotive Works, was present to explain the good features of the snow plows.

Brill Trucks.

THE JOHN A. ROEBLING'S SONS COMPANY, Trenton, N. J., the well-known manufacturer of bare and insulated wire and wire rope, was represented at the convention by Messrs. H. L. Shippy, G. C. Bailey, M. R. Cockey and W. L. Doyle.

MESSRS. McCARDELL, WEST & CO., Trenton, N. J., had on exhibition the Trenton trolley wagon. Mr. J. R. McCardell represented the company and interested many of the railway men by illustrating the various uses to which the wagon could be put.

THE OKONITE COMPANY, New York, had on exhibition samples of Candee feeder wire, insulated sheeting for cars, and other well-known specialties of the company. Capt. W. L. Candee was present in person, and the captain is always a host in himself.

THE PETTINGELL ANDREWS COMPANY, Boston, had on exhibition the Trojan leverage jack, which is used for emergency work and lifting car bodies without blocking. Mr. J. E. Wilson explained the advantages of this jack and interested many of the visitors.

THE GARL ELECTRIC COMPANY, Akron, Ohio, displayed its telephone

system for street railways in operation. Mr. M. Garl, president, looked after the interest of his company, and reported a large number of orders from railways for equipment with his telephone system.

THE CONTINUOUS RAIL JOINT COMPANY OF AMERICA, Newark, N. J., showed its rail joints, through Mr. W. F. Ellis, who also represented Messrs. J. H. Sternberg & Son, of Reading, Pa., and for the latter concern exhibited Harvey grip-rolled thread steel bolts.

MR. W. T. VAN DORN, Chicago, was present to show his automatic car-coupling devices, and was jubilant over having just contracted for the equipment of the Central London Underground Railway with his couplers. He took one order at the convention for over 200 coupler parts.

THE E. T. BURROWES COMPANY, Portland, Me., had a display of the many styles of car shades and car curtains which it manufactures. It also distributed a very useful souvenir in the form of a pocket dictionary, Mr. W. L. Calhoun and Mr. H. H. Russell represented the company.

THE ROCHESTER HOSE BRIDGE COMPANY, Rochester, N. Y., exhibited a hose bridge, which prevents the delaying of cars in case of a fire along the line. Mr. R. P. Barbour represented the company and gave practical demonstrations on the Niagara Railway of its usefulness.

THE H. B. CAMP COMPANY, Aultman, Ohio, made an exhibit of the Camp underground and Camp insulating conduit. This conduit, which is now being extensively used, is steel armored and lined with vitrified clay or other vitrous material. Mr. A. L. Daniels represented the company.

THE LOMBARD WATER-WHEEL GOVERNOR COMPANY, Boston, was represented by its consulting engineer, Mr. Allan V. Garratt, who interested many users of water power in the Lombard governor. The Lombard Hydraulic Brake Company was ably represented by Mr. H. M. Daggett.

MR. JOHN T. McROY, of New York and Chicago, attended the convention in the interests of his vitrified clay conduit, of which several specimens were shown, as well as a sample impervious asphalted joint. The 2, 3, 4 and 6-duct conduit, which is very widely used, is made in 6-foot lengths, glazed inside and out.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, New York, had a practical exhibit of its enclosed-arc lamp and quick-break switches. Four arc lamps were operated in series at 500 volts. Mr. E. A. Lavins looked after the interests of the company and made a very favorable impression with his goods.

CONSOLIDATED CAR FENDER COMPANY, Providence, had on exhibition one of the well-known Providence fenders, showing special styles of equipment and the methods and appliances for attaching the fender. Col. A. P. Woodworth, Mr. A. C. Woodworth and Mr. G. H. Hale represented the company.

LESCHEN-MACOMBER-WHYTE COMPANY, Chicago, whose flattened strand wire ropes and iron, steel and copper wire, both bare and insulated, are well known to street-railway men, was represented by Mr. G. S. Whyte, who presented the vistors with a copy of Eugene Field's famous poem, "The Clink of the Ice."

THE WELLS & FRENCH COMPANY, Chicago, exhibited a Curtis truck, upon which was mounted a Price momentum friction brake, both being of its own manufacture. The workings of the brake were exhibited to admiring crowds, while Messrs. Frederick Saxelby and W. G. Price were kept busy explaining its operation.

ST. LOUIS REGISTER COMPANY, St. Louis, had a number of car registers on exhibition, and was represented by Mr. G. H. Allison, of New York, who also represented the Hildreth Varnish Company, of New York; the Hunter Illuminating Sign Company, of Cincinnati, and the Columbia Refining Company, of New York.

THE JOHN STEPHENSON COMPANY, New York, pioneer builder of street cars, was represented by Messrs. D. W. Pugh and J. A. Tackaberry, two of the best known and most popular men in the business. The Stephenson Company distributed a neat memorandum book as a souvenir, containing illustrations of the earliest and latest styles of street cars.

THE TAYLOR ELECTRIC TRUCK COMPANY, New York, exhibited in the main building a variety of single and double trucks, and a set of the well-known Empire State radial trucks. Outside they had a regular single truck with pipe bracing, for long open cars. Mr. John Taylor, Mr. G. A. Tupper and Mr. A. T. Reynolds comprised the staff of this company.

SKEEN ELECTRIC SWITCH & SIGNAL COMPANY, St. Louis, had an interesting exhibition of the Skeen automatic magnetic regulator for regulating lamps and car heaters in service at a constant potential; all the Skeen automatic safety electric-signal system, and the Skeen semophore block signal, and an automatic trolley catcher. Mr. Robert Skeen was in attendance.

THE SARGENT COMPANY, CHICAGO, made a very neat display of its brake shoes. These are composed of a mesh of soft steel stampings, cast full of gray iron, thus gaining wearing qualities and strength without decreasing the life of the shoe. The interests of the company were in the competent hands of Messrs. F. W. Sargent, the secretary; George H. Sargent and A. T. Herr.

THE PAPER VENDING MACHINE COMPANY, St. Louis, exhibited a slot-machine device to sell newspapers on street cars. The machine operates by placing a coin equivalent to the price of the newspaper in the slot. The weight of the coin releases the mechanism and frees one copy of the paper. R. A. Schlegel and F. H. Wind explained the application and use of the apparatus.

THE McGUIRE MANUFACTURING COMPANY, Chicago, had an exhibit which consisted of a variety of its well-known trucks, located in various parts of the convention hall; also a McGuire sweeper, the Columbia car stove and the McGuire ratchet brake handle. Messrs. W. A. McGuire, W. J. Cooke, G. F. Collins and M. G. Hubbard were present in the interests of the McGuire Company.

CLONBROCK STEAM BOILER COMPANY, Brooklyn, had on exhibition a complete model of the well-known Clonbrock boiler, and also showed photographs of various stations in which its boiler is used. This company distributed a very interesting photographic souvenir, showing some of the important Clonbrock installations. Mr. T. F. Morrin, president of the company, and Mr. C. H. Sammons were present.

MESSRS. HERRICK & BURKE, New York, showed a controlling electrical-inspection system, which they install in car houses for the purpose of discovering any trouble arising in car equipments. By the use of this system any defects can readily be detected. This system is now being introduced with great success, and Mr. A. B. Herrick personally interested a large number of practical railway men in its workings.

THE R. D. NUTTALL COMPANY, of Allegheny, Pa., showed a fine collection of gears, pinions, trolleys and brass goods. The new material, "Steelite," from which it is now making electric-railway gearing, attracted much attention. The company was represented at the convention by Messrs. F. A. Estep, president; C. N. Wood, George W. Provost, Garson Myers, Scott R. Hayes, Charles Bartlett and A. S. Partridge.

THE FALK MANUFACTURING COMPANY, Milwaukee, Wis., exhibited sections of rail with joint, and the new process of cleaning the rail for welding. By this system, which makes practically a continuous rail, the Falk Company claims that a much larger carrying capacity is obtained at the welded joint than by the rail itself. Mr W. F. Herman, Mr. E. A Wurster and Mr. Henry L. Prather were the representatives of the company.

MR. ELMER P. MORRIS, New York, had a large and attractive exhibit of the many articles manufactured by the numerous firms he represents. He showed a full line of electric-railway equipments for all classes of construction, iron poles, steel gears and pinions, insulating paint, reflectors, car-curtain fixtures, car signs, etc., etc. Mr. Morris entertained his friends in his usual hospitable manner, and infused much life into the convention.

THE CONSOLIDATED CAR HEATING COMPANY, of Albany, N. Y., made a handsome display of its electric car heaters, and also of electric heaters for general purposes. An interesting feature was the controller, giving five intensities of heat by combinations of the heaters in each car. Mr. J. F. McElroy, consulting engineer; Mr. H. F. Ransom, Eastern agent, and Mr. W. P. Cosper, Western agent, represented the company at the convention.

THE STOREY MOTOR & TOOL COMPANY, Philadelphia, whose well-known enclosed motors and dynamos continue to increase in popularity, was represented by its president, Mr. . E. Storey. Few who attended the convention were more pleased than was Mr. Storey with the exhibits, the attendance and the interest displayed by the delegates. Mr. Storey has many friends and admirers in the electrical business, and deserves to have.

THE DIAMOND TRUCK & CAR GEAR COMPANY, Kingston, N. Y., had two single trucks and two double trucks of its "Standard" 3 and 5, and "Standard" double types as the principal features of their well-arranged and attractive exhibit. Messrs. W. H. Wilkinson, general manager; W. H. Ten Broeck, E. F. Hutton and F. T. Pullen were present to advance the interests of Diamond trucks. The whole exhibit was sold during the convention.

A DAINTY DINNER given at Buffalo Tuesday evening by Mr. J. G. White, of New York, was one of the features of the Street Railway Convention. Not only is Mr. White personally a charming gentleman and an ideal host, but he ranks at the top of his profession as a constructing engineer. The power-transmission line between Niagara Falls and Buffalo, illustrated and described in THE ELECTRICAL WORLD of June 19, 1897, was built by Mr. White.

THE CENTRAL ELECTRIC COMPANY, of Chicago, exhibited a fine collection of specialties, including, among others, Garton lightning arresters, Helios enclosed-arc lamps, Billings & Spencer drop-forged commutator bars, Bound Brook bushings, Pittsburg drawn trolley tubes, and a full line of overhead-construction materials. Messrs. W. R. Garton, manager of the railway department, and H. E. Adams, Eastern agent, represented the company at the convention.

MR. J. R. CRAVATH, representing the Cravath Manufacturing Company, Chicago, exhibited a most ingenious excessive-current recorder, or instrument for keeping track of careless motormen. It consists of a hot wire in the main car circuit, over which a flexible ribbon is fed by a weight. The amount of this melted after a run furnishes a precise criterion of the motorman's care in the use of current. The simplicity and ingenuity of the device attracted marked attention.

THE H. W. JOHNS MANUFACTURING COMPANY, New York, displayed a line of electric heaters in operation for both panel and cross-seat cars. The regulating switch for these heaters attracted much attention, 3 degrees of temeprature being obtainable. A number of appliances for electric-railway work were also shown, together with the new toggle-clamp pole insulation, and the Luscomb clips for figure-8 trolley wire. Mr. J. Emery Meek and Mr. H. H. Luscomb represented the company

THE GOLD STREET-CAR HEATING COMPANY, New York, exhibited a very taking display of electric-car heaters and room heaters. The car heaters were shown in a variety of forms adapted to cross-seat cars, or for use inside the risers of seats of the ordinary longitudinal pattern. Mr. Edward E .Gold, president, who was assisted by Messrs. H. E. Beach, John E. Ward and William E. Banks, reported that the convention had been the occasion of much profitable business for his company.

THE DUPLEX CAR COMPANY, Boston, operated one of its cars, carrying passengers from the hotels to the convention building. The car attracted much attention and much favorable comment. It is adapted for both summer and winter use, and can be changed from an open to a closed car in a very few minutes. Mr. John A. Lowell, president of the company, and Mr. Charles

Exhibit of the General Electric Company.

O. Stearns, secretary, were on hand to explain its advantages. This car was constructed by the Jackson & Sharp Company, Wilmington, Del.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, brought their new graphite wood-gear grease for trolley-car use prominently before the delegates. This product is a mixture of the best Ticonderoga flake graphite, cedar wood pulp and lubricating fats, and reduces the noise from gears to a minimum, and being practically a solid, does not drip or ooze from the gear case. As usual, the Dixon Company was liberal in the distribution of a variety of souvenir pencils. Mr. J. H. Baird and Mr. A. L. Haasis did the honors.

MURPHY MANUFACTURING COMPANY, Pittsburg, had an operative exhibit, showing the Murphy car-wheel grinder in practical use. Mr. Murphy is a practical street-railway man, and his device attracted much attention from the delegates. A most interesting feature of this exhibit was the motive power, which was furnished by an old-type 10-hp Sprague motor. This machine was

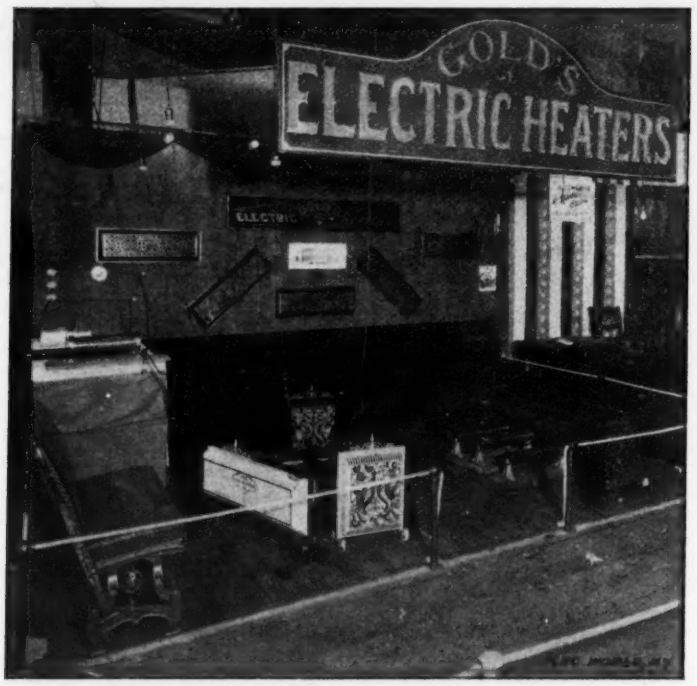
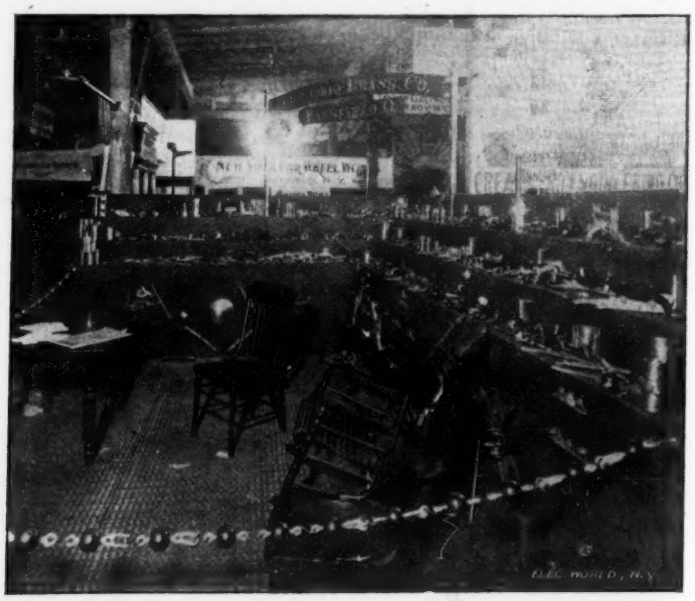


Exhibit of Gold's Electric Heaters.

one of the first motors sold to the Pleasant Valley Railroad Company, of Pittsburg, over ten years ago, and has been in constant use ever since. Messrs. John Murphy and John Daly were in charge of the exhibit.

MR. HAROLD P. BROWN, New York, interested many of the delegates in his various bond specialties. The E. C. A. rail bond for rebonding rails on paved streets without disturbing the pavement, the plastic rail bond, the socket bond, and also various tools and appliances for use in the application of the above specialties, together with a small gas engine shown in operation for the purpose of brightening connecting points in rails, were some of the features that went to make up this practical exhibit. Mr. Harold P. Brown, of New York, and Mr. Franklin Sheble, of Philadelphia, were in charge.

THE MILLER-KNOBLOCK COMPANY, South Bend, Ind., had an assortment of assembled commutators for street-railway motors. A careful examination showed these to be manufactured in a most skillful manner, and the exhibit attracted much attention from street-railway managers. This company is rapidly adding to its reputation by the good quality of its work. It also



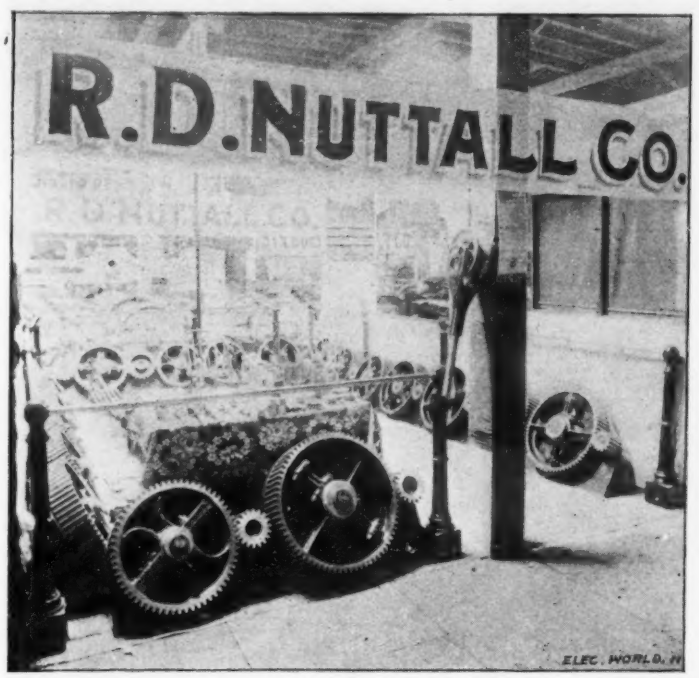
The Ohio Brass Company's Exhibit.

had on exhibition some photographs, illustrating its wide-throwing sprinkling car for use on electric roads. This car will cover a street from curb to curb 100 feet wide at one passage. Mr. A. W. Morrell, the electrician of the company, and himself a practical street-railway man, was in charge of the exhibit.

THE OHIO BRASS COMPANY, of Mansfield, Ohio, had one of the most tastefully arranged exhibits. Inside a fence formed of strain insulators a bewildering variety of overhead construction and track-bonding material was exhibited, in addition to which commutators and bearings for all sizes and types of railway motors were shown. A full line of newly designed material for "figure-8" trolley wire and other special shapes was also exhibited, as were headlights, track brushes, gongs, etc. A very neat souvenir pin, on which a little thermometer was coiled, was lavishly distributed, and soon came to be almost a distinctive mark of the delegate. The representatives of the company present were Messrs. C. K. King, secretary, and A. L. Wilkinson, special salesman.

THE CRANE COMPANY, Chicago, made a very elaborate display of steam specialties and valves and fittings for high-pressure work. Among the features of the exhibit were a 24-inch steam valve weighing 3½ tons, and designed for a working pressure of 250 pounds. The variety of check valves, gate valves, globe valves, pop safety valves, steam traps, and other steam fittings, crowded into the space occupied by the Crane Company was almost bewildering. Among the specialties were globe and check valves tested to 5000 pounds per square inch, forthe heaviest class of hydraulic work. The aluminum gate valve, whose presence has graced many a former display of these goods, was in evidence also. The exhibit was in charge of Mr. G. A. Hurd, of the engineering department, and Mr. R. T. Crane, Jr.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, Philadelphia, exhibited a complete line of its switchboards and portable instruments. The exhibit was tastefully arranged and attracted considerable attention. The exhibition board was carved from a joist taken from the house in which it is said Thomas Jefferson drafted the Declaration of Independence. Among the



THE R D. NUTTALL CO.'S EXHIBIT.

special features of this exhibit was a new potential and current indicator. There was also shown for the first time a new form of portable direct-current voltmeter, the instrument on exhibition being specially designed to test the drop in rail joints. The exhibit, which was in charge of Mr. J. F. Stephens, represented the rapid progress in this line of work which the Keystone Electrical Instrument Company has made during the last year.

THE PECKHAM MOTOR, TRUCK & WHEEL COMPANY had an elaborate and attractive exhibit in the centre of the hall. The company showed a variety of trucks, comprising all kinds and sizes, showing the progress of manufacture in this line, from the lightest truck to the heavy truck for electric locomotives. The literature distributed by the Peckham Company was greatly admired, and the handsome ladies' souvenir of the Falls was much sought after. The visitors at the exhibit were entertained by Mr. Edgar Peckham, Mr. A. W. Field, Mr. J. E. Long, Mr. W. H. Gray, Mr. Charles Ackley, and last, but not least, Mr. J. A. Hanna, one of the pioneer salesmen in this field. The Peckham reception parlor at the International Hotel was handsomely decorated, and here were shown several of the finest models of Peckham types of trucks ever exhibited.

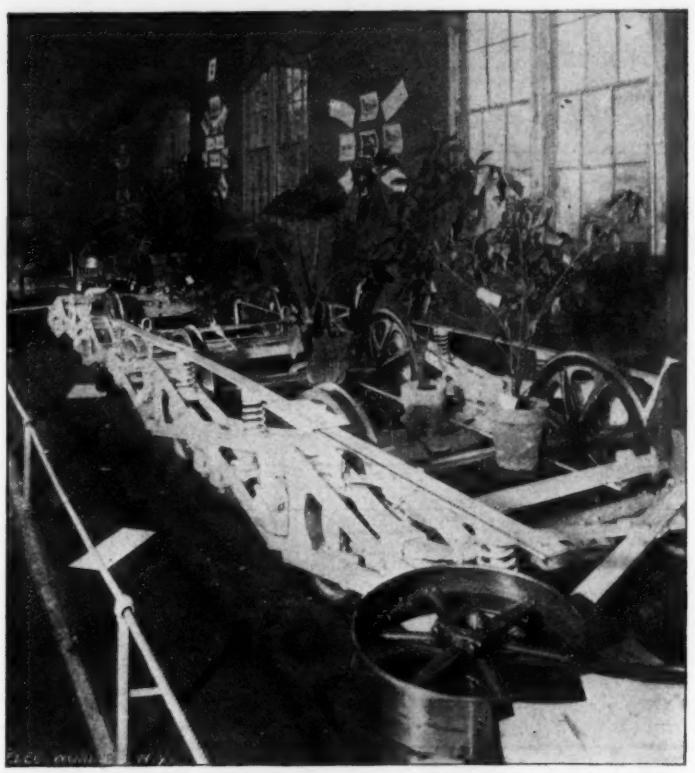
NEW HAVEN CAR REGISTER COMPANY, New Haven, Conn., had a very attractive display of its various styles of registers. The most interesting feature of this exhibit was the double register for use on connecting roads, where one conductor leaves a car and his place is taken by another. This register is in two separate sections, both complete in one case. Each conductor has absolute control over his side of the register, and on leaving the car locks the register by a special lock, to which he only has the key. This does away with changing registers. Another feature of this register is that both sides are operated by the same rod. Messrs. J. S. Bradley, W. M. Anthony, F. C. Boyd, A. W. Chappell and A. M. Loper were the representatives of the company, and presented to the delegates a very handsome souvenir in the shape of a paper knife.

THE MICA INSULATOR COMPANY, of New York, Chicago and London, made a large display of commutator rings, segments, troughs, tubes, discs, plates and various forms of insulation. The company's new product, known as M. I. C. compound, was for the first time exhibited. Some ten different grades and styles of Micanite and Empire cloths and papers were shown. This was probably one of the largest exhibitions of insulating material ever shown, and goes to show the progress which the company has made during the past four years in this branch of electrical industry. By the use of "Micanite" in the construction of the apparatus the success of electrical motive power has been greatly helped. Mr. Charles E. Coleman, of the Chicago house, was in attendance, and had charge of the exhibit. Mr. Franklin Brooks, vice-president of the company, was also in attendance one or two days.

THE STANDARD THERMOMETER & ELECTRIC COMPANY, of Peabody, Mass., made a display of enclosed arc lamps. Their Upton Midget lamp for street-railway circuits is so constructed that it will operate successfully five in series on circuits varying from 475 to 550 volts. Each lamp is provided with resistance and automatic cut-out, enabling one or more lamps of the series to be thrown out of circuit without affecting the light of the balance of the lamps. The lamps can be adjusted to take from 3 to 5½ amperes, as may be desired. The company displayed the lamps with various finishes of cover, showing both the plain and ornamental lamps without hoods for indoor service, and with hoods for street service. The lamp mechanism is so constructed that if the carbons in one lamp of the series burns out that lamp automatically cuts itself out of the circuit and can be trimmed while the balance of the lamps are burning.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, made an exceedingly interesting showing of the capabilities of storage batteries in railway service. A large battery was arranged across the mains of a 110-volt circuit, which was arranged to be closed by a switch through a small resistance, thus giving a current of about 200 amperes. Meters in the mains feeding the battery showed the greatest steadiness of current consumption and voltage, even when the switch handling the 200-ampere discharge current was rapidly manipulated. The representatives of the company present were Mr. Herbert Lloyd, general maanger; Mr. J. B. Entz, Mr. F. J. Clark, Mr. Charles Blizard, and Mr. J. Y. Bradbury. In their pleasant quarters in the International these gentlemen answered many interested inquiries from delegates who have recently been studying the subject of accumulators for street-railway service.

THE STANDARD AIR BRAKE COMPANY, of New York, had an exhibit of air brakes, which practically illustrated the different types of apparatus manufactured from the beginning of its business to date. A Brill No. 27 truck was equipped with the company's duplex compressor, direct axle-driven, and on another truck of the same make was shown the geared compressor. The Standard Company's hollow spindle brake cylinder, with fulcrum on the back head for equalizing double-track brake rigging, was also exhibited. There was also shown the Standard interlocking handle, by means of which the con-

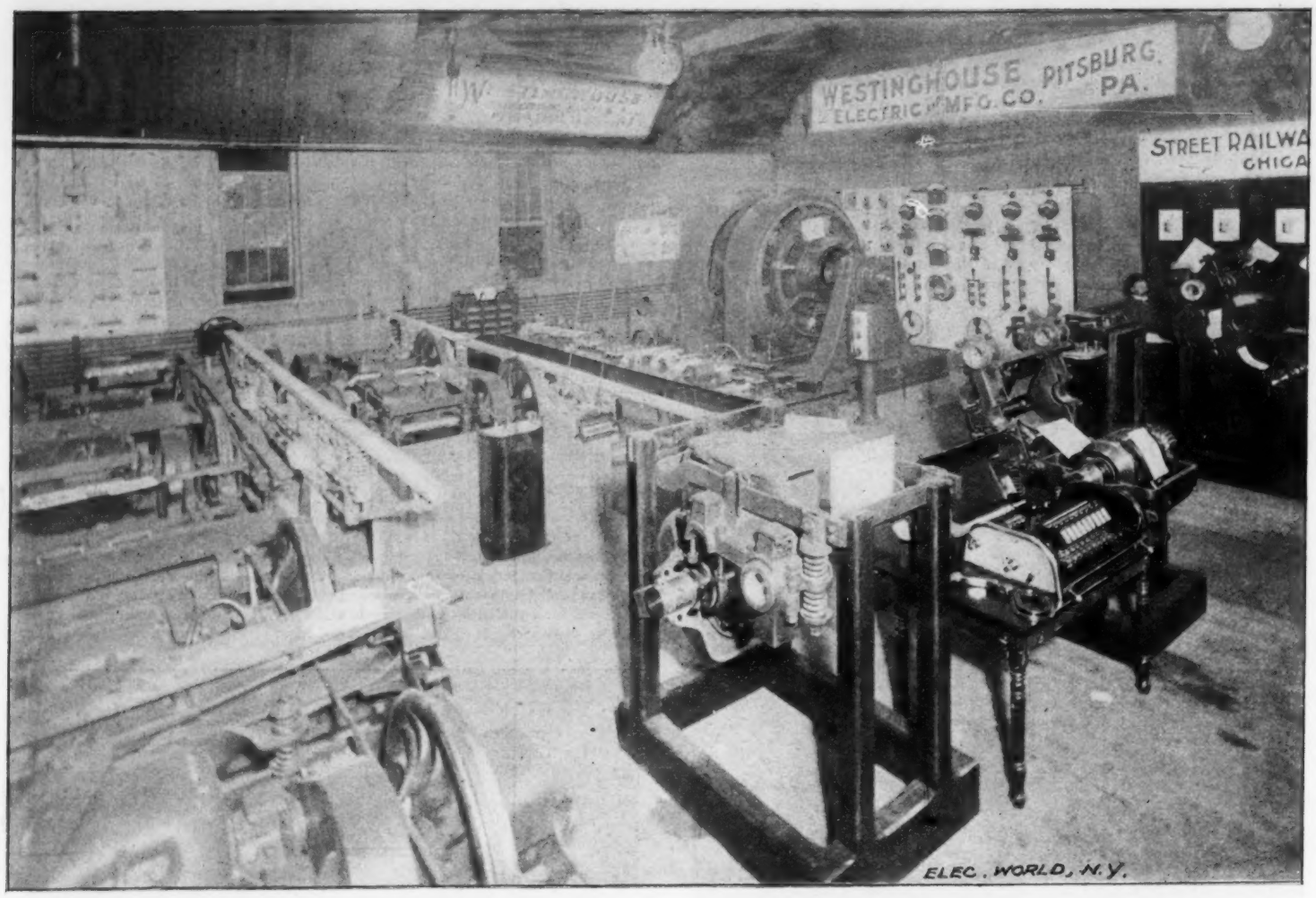


DIAMOND TRUCKS.

trolling valve was worked, also the chime whistle. The automatic-current controller and the company's water and dust-proof electric compressor were also exhibited. The company was represented by Messrs. E. J. Wessels, E. H. Dewson, Jr., George E. Pratt, C. B. Fairchild, H. B. Taylor and E. E. Robinson.

THE CLARK BRAKE COMPANY, Pittsburg, attracted the attention of many delegates by the excellent exhibition of its hydraulic brake. The brake was shown in operation on a DuPont truck equipped with Steel motors, and also on a Lord Baltimore truck. The brake consists of a hand-operated double pump bolted to the front platform of the car. The piston of the pump is moved by a lever, requiring about 1½ strokes to apply the brake in ordinary cases where 50 pounds pressue is required. The brake is apparently a very simple piece of mechanism, and the liability of its getting out of order is reduced to a minimum. The liquid used in this brake in the summer is 85 per cent. of water and 15 per cent. of glycerine, and in winter 50 per cent. of each. The Steel Motor Company, of Johnstown, Pa., manufactures the brake. Messrs. F. L. Clark, the president; J. M. Tate, the secretary, and H. S. Clark, the engineer of the company, were present and were kept busy in explaining the operation and merits of the brake.

THE CHRISTENSEN ENGINEERING COMPANY, Milwaukee, made a large and interesting exhibit, consisting of a test rack for a train of twelve



The Westinghouse Exhibit.

E. P. Morris's Exhibit.

Scott's Springs.

International Registers.

cars, equipped with automatic air-brake. The air pressure was furnished by an automatic controller-motor compressor of a capacity of 40 cubic feet of free air per minute, the action of the brake being controlled with a new form of engineer's valve. This compressor furnished air for operating brakes on a heavy motor car and two heavy trailers. In addition the Christensen Company exhibited a motor compressor, having a capacity of 9 cubic feet of free air per minute, which was connected to an engineer's valve, piping and brake cylinder, suitable for high-speed heavy motor cars; also an axle-operated air compressor on a DuPont truck, equipped with Steel motors. This equipment was provided with a main reservoir engineer's valve and brake cylinder for motor car in ordinary city service. Messrs. N. A. Christensen, Mr. Garson Myers and Mr. F. C. Randall, the representatives, were much pleased with the interest shown by street-railway men in the exhibit.

THE JOHNSON COMPANY, Lorain, Ohio, and Johnstown, Pa., as usual, made an effective exhibit of special track work, showing 9-inch rail "guarantee" construction, a girder crossing of 100-pound rail, frogs made in like manner of 6-inch T-rail, and the type of steam crossing known as the "Pennsylvania Railroad Standard," built in the most substantial manner, a single crossing of 75-pound steel rail, weighing 4200 pounds. The "guarantee" process of this company consists of a steel plate hardened by the Harvey process and inserted at the crossing point of the frog or crossing in such a manner as to be renewable without disturbing the surrounding pavement. A number of such crossings have been laid for the Consolidated Traction Company, Pittsburg. A single and a double Dupont truck, the former equipped with the steel motors and the Clark air-brake in operation, completed this interesting exhibit, which was in charge of Daniel Coolidge, Major H. C. Evans, A. S. Littlefield, W. E. Boughten, Randolph Clitz, O. C. Evans, W. W. Kingston, S. P. S. Ellis, E. B. Entursle and John K. Frye.

EUGENE MUNSELL & CO., New York and Chicago, made a fine display of their "India and amber mica," both in the sheet, as it comes from the mines, and in the form of segments for railway motors. The exhibit was made in connection with that of the Mica Insulator Company. Several sets

THE CENTRAL ELECTRIC COMPANY'S CORNER.

of segments of various sizes were attractively displayed beneath a large sign-board on which was shown a full line of drop-forged copper segments, made by the Van Wagoner & Williams Hardware Company, for whom Eugene Munsell & Co. are general Western selling agents. At the entrance to the booth was shown "India mica" cut in sizes from 9-16 x 4½ to 8 x 10 inches. This large range of sizes show that the firm is prepared to furnish "mica" in almost any size, shape or pattern. A souvenir in the form of a "mica mine" puzzle was given, and was probably sought for as much as any one souvenir at the convention. Parties not in attendance can secure these souvenirs by writing the company at either New York or Chicago. The exhibit was in charge of Mr. Charles E. Coleman, of the Chicago house.

THE J. G. BRILL COMPANY, Philadelphia, made a very extensive exhibit in the convention hall, comprising about all the styles of trucks which the company manufactures. In addition the Brill Company also had a display outside the building, consisting of a Brill sweeper and a standard 10-bench open car. There are, however, so many Brill cars and trucks in use in and about Niagara Falls, that it hardly seemed necessary to make any other exhibit at the convention. One new feature of the Brill exhibit was the new novelty alarm gong. The special points of this gong are the impossibility of losing the plunger, as it is permanently fastened to the floor, and the fact that the hammer cannot be held against the gong more than a moment at a time. This overcomes the unpleasant chattering noise so familiar to street railway men, and prevents the crystallization of the gong. The delegates were very much interested in this, as well as in the useful souvenir, Cox's Electric Traction Computer. The company also had a handsome reception parlor at the International Hotel, where hospitality was dispensed in the manner for which the Brill Company is famous. Messrs. John A. Brill, Edward Brill, S. M. Curwin, W. H. Heulings, Jr., D. M. Haskell and W. H. Archer were the representatives.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY'S exhibit attracted attention by its completeness and the general taste with which the apparatus of the company had been arranged. The "Booster Outfit," consisting of a compound-wound motor, driving a 300-hp series wound generator, with the necessary switchboard appliances, displayed on a marble switchboard, was the subject of general interest to all. Beside this outfit the

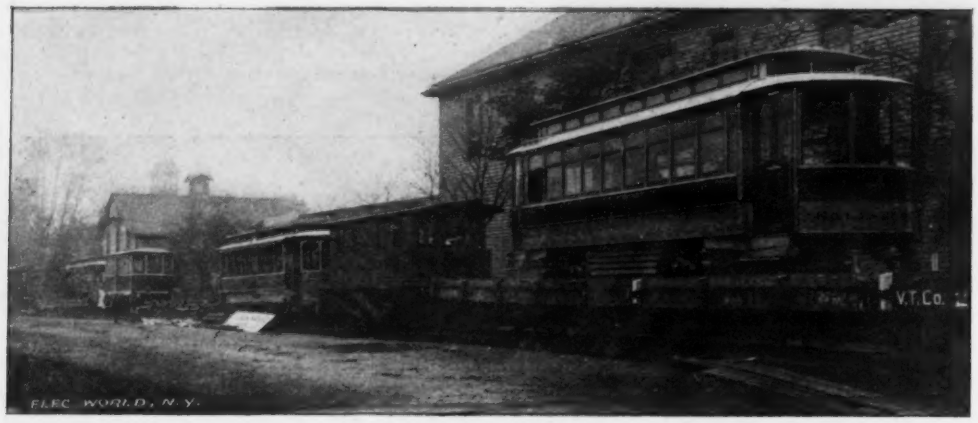
"MICANITE."

Westinghouse Company exhibited a complete line of all kinds of electric-railway appliances, motors of all sizes and types, from 150-hp electric locomotive equipments to the smaller standard electric street-railway motors. There

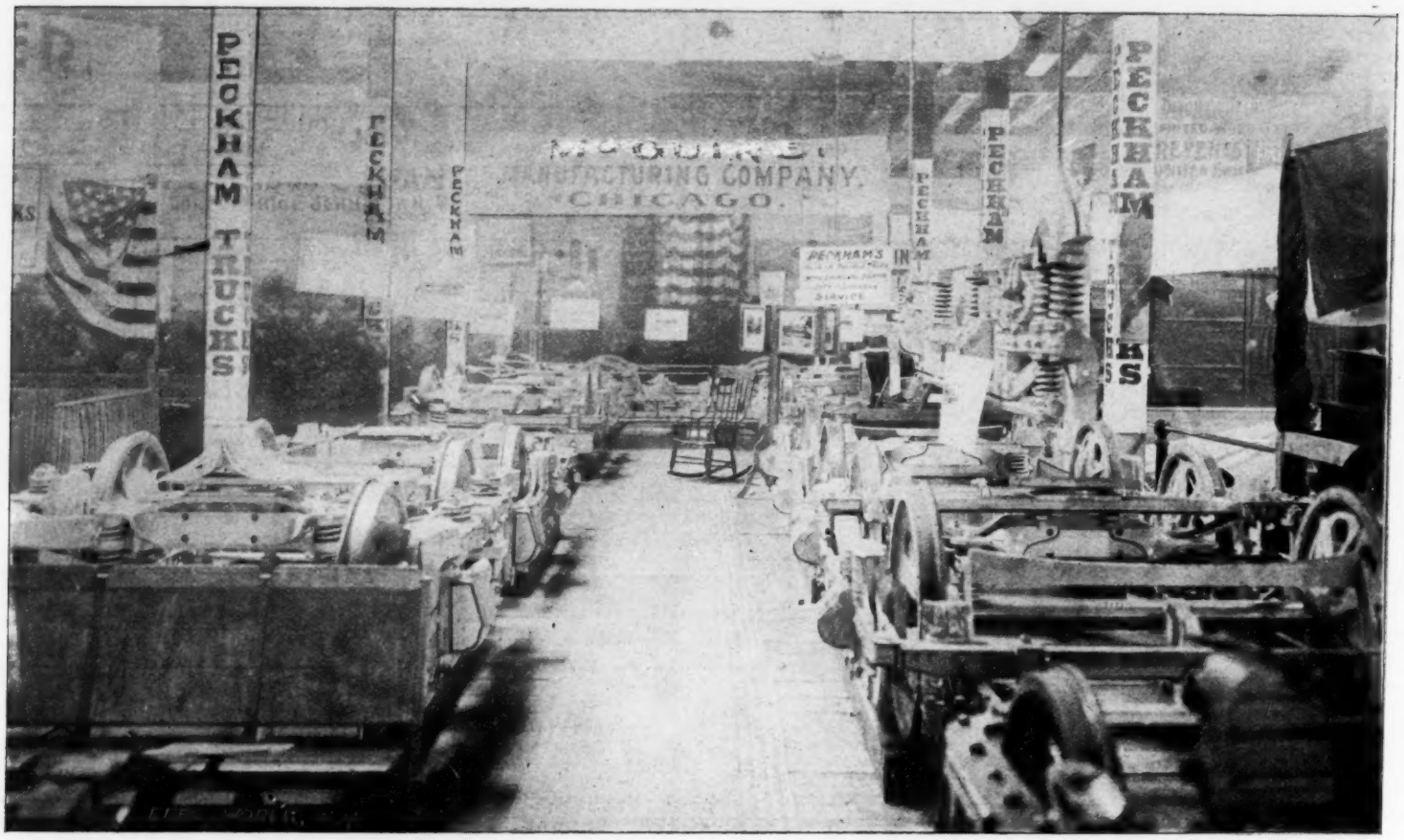
CHLORIDE ACCUMULATORS.

were also controllers of all sizes, switches, circuit breakers, diverters and lightning arresters. Literature and photographs, descriptive and illustrative of the Westinghouse electric-railway system were also abundantly distributed. The personnel of the company's representation was as follows: Messrs. W. K. Dunlap and M. McLaren had charge of the exhibit. The others present were: Messrs. C A. Bragg, of Philadelphia; R. S. Brown, of Boston; J. R. Gordon, of Atlanta, Ga.; Maurice Coster, of Chicago; W F. Zimmermann, of New York City; Guido Pantaleoni, of St. Louis, and E. H. Heinrichs, Robert Siegfried, F. R. Storer, J. S. Mallet, of Pittsburg.

THE STEEL MOTOR COMPANY, of Johnstown, was the recipient of many compliments upon its attractive exhibit, part of which was shown in operation. The Steel Motor Company's new line of railway motors, exhibited



Exhibits Outside the Hall.


PECKHAM TRUCKS
PECKHAM
PECKHAM
PECKHAM

for the first time at this convention, attracted critical attention and evoked much favorable comment. There were seen double equipments of 25, 35 and 50 horse-power mounted on Dupont trucks; a 50-hp motor armature, with the leads disconnected from the commutator, was a unique feature. It contains thirty-three slots with only thirty-three coils. The Steel Motor Company claims to be the first to manufacture and put in service an armature of this description. The controllers also came in for a large share of attention by reason of their apparently simple, substantial and durable construction. One pleasing result to those in attendance on this exhibit came in the form of an order for fifteen doubleequipments, and another for ten double equipments. Mr. J. A. Rutherford, general sales agent, had direct charge of the exhibit, and was one of the most indefatigable workers at the convention. There were also present from the Steel Motor Company Mr. J. N. Thomas, vice-president and general manager; Mr. R. T. Lane, secretary and treasurer, and Mr. A. D. Henry, electrician, and they all left Niagara feeling that the benefit of the exhibit would be felt by the company for many years to come.

THE WALKER COMPANY, of Cleveland, made an excellent showing of its electrical-railway machinery, which kept scores of interested spectators before it. The feature of the exhibit was the 400-hp elevated-railway truck, which furnished an example, perhaps never before equaled in mechanical traction, of concentration of great power in small space. It consisted of a McGuire truck fitted with two No. 25 Walker elevated-railway motors of 200 horse-power each. It was especially designed for the extremely heavy work to be met with in elevated traction, and is capable of accelerating a three-car train to a speed of 25 miles per hour in eighteen seconds. A double 4-A equipment, consisting of two 30-hp Walker motors, was shown on a Peckham truck. This, with the electric-brake controller, formed an example of the Walker Company's standard equipment for street-railway work. The controller (type J 2), has been designed to meet the demand for quick-acting brakes, which will not clog the truck with special gearing. To apply the brake the reverse handle is turned to the appropriate notch, which opens the trolley circuit and converts the motors into generators, the current developed being absorbed in a rheostat. The contacts are so arranged that it can be used either for ordinary or emergency stops. In addition to these two trucks a third was shown, designed for interurban service. This truck, a Dorner & Dutton, was fitted with two 50-hp motors, and comprised, with the controllers shown, the Walker 10-S double equipment. Noticeable among the large number of motors shown was a 2-N 20-hp motor, designed for narrow-gauge work. One hundred and twenty of these motors have been sold in a single order to the Oberschlisische Dampfstrassenbahn (the Upper Silesia Steam Street Railway), in Prussia, an "electrified" steam road, with only 31-inch track gauge. A 150-kw eight-pole, 500-volt Walker street-railway generator, was on exhibit, as was also a 25-kw 110-volt machine. The latter is the smallest dynamo manufactured by the Walker Company. At the back of the booth was shown a large switchboard built for the Tamaqua & Lansford Railway. This was arranged for two 225-kw railway generators, and had four feeder circuits. The board consists of four white marble panels mounted on an iron frame. Upon one panel are mounted the generator-circuit breakers, ammeters, switches, lightning arresters and rheostats. On another are the main ammeter, a recording wattmeter and a recording voltmeter, all showing the total output of the station. On the other two are the circuit breakers, ammeters, switches and lightning arresters for the various circuits. A solenoid blowout controller was shown, embodying the Walker method of cutting out motors. To accomplish this there are six positions appropriately marked for the reverse lever instead of merely the usual "forward" and "reverse," viz.: Both motors ahead; No. 1 motor ahead, No. 2 motor cut out; No. 2 motor ahead, No. 1 motor cut out; both motors back; No. 1 motor back, No. 2 motor cut out; No. 2 motor back, No. 1 motor cut out. The operation of cutting out the motors is as simple as reversing the car. There are five running positions of the controller. These are arranged for uniform graduations of speed, and the rheostat is so proportioned that the car can be run any length of time on any notch. The reverse cylinder is locked by a magnetic locking device, which makes it impossible to move the reverse when current is flowing through the controller. The solenoid blowouts are embodied in the partition between the controller fingers. This protects them from injury by the arc. The Walker Company was represented by the following gentlemen: S. H. Short, Cleveland, Ohio; F. W. Ferguson, Cleveland, Ohio; B. M. Barr, Cleveland; J. S. Anthony, Cleveland; H. McL. Harding, New York; Samuel Craft, New York; Henry G. Issertel, New York; R. A. Byrnes, New York; Charles N. Black, New Haven, Conn.; H. Burton Gay, Baltimore; Alexander T. Moore, Pittsburg; J. Holt Gates, Chicago; Charles E. Bibber, Boston; H. A Johnson, Toronto.

THE GENERAL ELECTRIC COMPANY had the most extensive exhibit at Convention Hall, consisting of motors, controllers, meters and subsidiary apparatus. Its quarters were in the southwest corner of the main hall, making there a brilliantly illuminated centre of attraction for the members of the association. The motor exhibit comprised motors of the latest types, most of which were mounted and connected up. One McGuire pivotal truck was equipped with a General Electric 51-80-hp motor on one axle, and an electric brake on the other, both controlled by a B 7 controller. Another truck of similar make and type carried on one axle a General Electric 53-50-hp motor of special build for narrow-gauge work, and an electric brake. A Brill No. 27 truck was equipped with two General Electric 57-50-hp motors, with an electric brake on each axle.. This is the equipment used in the high-speed work on the Cleveland and Lorain road. To accommodate both motor and brake on the same axle the wheels are dished. The equipment was controlled by a B 8 controller. A Diamond truck also carried two General Electric 57 motors, without brake equipment. On a Peckham flexible cantilever truck were mounted two General Electric 52 27-hp motors, with R 10 controller. All these equipments were arranged to show the operation of both motors and brakes. The equipments of the two McGuire trucks were controlled by one controller, and were run either singly or both together. On each of the above equipments was set a Thomson recording car meter, for use on the car itself, serving to show how a check may be placed on the performances of motormen with the controller. Three boards were erected in the space. The first was devoted to circuit breakers of the K. L. Q. and M. types, with magnetic blowout, each of which could be shown in operation by means of a special switch, currents up to 200 amperes being ruptured. Upon the second was mounted an extensive line of instruments used in street railway and general work. These comprised the new electro-static ground detector, Thomson inclined coil instruments of the portable and switchboard types, Thomson arc ammeter, astatic ammeter, G 2 astatic recording, wattmeter for station output measurements, portable indicating wattmeters and pocket ammeters and voltmeters. This board was surmounted by one of the new General Electric edgewise ammeters. The third board was equipped with M. D. magnetic blowout lightning arresters, both open and closed. These were shown in operation, the equivalent of the lightning flash being obtained from a Thomson X-ray inductorium, the flash being followed by currents from the 500-volt circuit. This exhibit attracted considerable attention from the railroad men, to whom its operation was fully explained by Mr. H. C. Wirt. They were enabled to appreciate the method by means of which lighting discharges on lines are safely handled. To exemplify the action when a high-potential wire falls across trolley wires a voltmeter was used. The pressure being brought up to 2000 volts the arrester came into action, showing that the current instead of passing through the apparatus would take its path through the arresters. The exhibition space was illuminated by a number of enclosed 100-hour arc lamps for use on railway circuits. In front was an ornamental cornice carrying colored incandescent lamps. Above and behind it was a large sign, with the company's name, and on the wall another giving concisely the railway record of the General Electric Company, viz., 2173 generators, aggregating 513,213 horse-power, 46,191 motors, aggregating 1,059,060 horse-power, and 4000 series-parallel controllers. The headquarters of the General Electric Company were in the writing room of the International Hotel. Here the company had erected a small booth in which an X-ray exhibition was given continuously. The social side was not neglected by the General Electric Company. On Tuesday it arranged an enjoyable tally-ho and carriage party over to Canada. This courtesy was taken advantage of by nearly every lady at the convention. Parlor D was the company's social annex, which, after about 9 P. M., seemed a remarkable centre of attraction for every one.

A "Surface Plate" Balancing Rig.

BY JAMES F. HOBART.

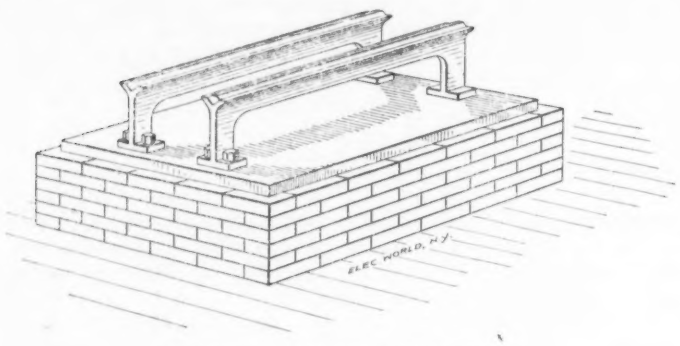
The accurate mechanical balancing of armatures is a matter of vital importance to length of life, but is often neglected, especially with street car armatures, when rewound in local repair shops. It would seem at first thought that armatures, being of a symmetrical construction, would not need any special attention to insure an accurate balance. This, however, as shown by experience, is not the case. Very probably the most serious source of unbalancing is due to the variable thickness of the core discs. These discs are punched from sheets which vary in thickness, due to slight inaccuracies of the rolls or to springing at their centres. A micrometer test of the thickness of such discs often shows very material differences between the two diametrically opposite sides. If the sheets are punched with key slots, the thick sides almost invariably come together, making one side of the armature considerably heavier than the other. A great deal of this could be eliminated by care in punching the discs from the sheets and alternating the thick and thin sides in the building up of the core.

In the Gramme, or ring armature, the addition of a weight to counterbalance the heavy spot is an easy matter, for the weight can be placed inside the ring, and can be moved axially to bring it immediately opposite the heavy place. This axial determination is a matter almost universally neglected in the balancing of armatures. The ordinary method of balancing is simply to place the shaft upon parallel ways that have been accurately surfaced and leveled to a horizontal plane. The armature is then rolled, and allowed to come to rest. If it invariably does so with the same side down, that side is known to be heavier than the other. By adding counterweights on the light side by a cut-and-try method, the balancing is effected. Naturally, in the average shop, the bed of a lathe first suggests itself for a balancing rig, and in many shops no better apparatus can be found than one that chances to be wide enough to sling the armature. The narrowness of lathe beds has, however, led to the placing of planed strips across the ways of the bed on which the armature could be rolled with the shaft parallel to the lathe bed. The difficulty with this rig is that few lathe beds are accurately placed in a horizontal plane, and if leveled ever so accurately they rarely stay so. If paced on an ordinary wooden floor, every time a ton or so of castings is piled near them the adjustment of the bed is changed. This variation in the position of the lathe has naturally led to provision being made for readusting the level each time the apparatus is used. To this end the strips that are used for rolling surfaces are made double, with hinges at one end and an adjusting screw at the other. The top strip is usually provided with a spirit level, placed in a cavity cored in the casting. By adjusting the screws, the bubles can be quickly brought to the central position, when it is known that the strips are horizontal. But this is not

perfectly satisfactory, as the strips should be made very heavy to give them sufficient rigidity to hold their alignment under heavy armatures. This requirement makes the portable apparatus quite unsatisfactory. The strips are apt to yield a little, and any little deflection of either strip will serve to destroy the accuracy of the balancing. Add to this the necessity for shutting down the lathe while the balancing is being done, and it will be seen that it would be better to make a simple special tool to do the balancing than to use an expensive lathe.

The outcome of the experience noted above was in one instance at least the building of a much more satisfactory testing apparatus. The design is shown in the illustration published herewith. It consists fundamentally of an iron plate 38 x 46 inches, and about 1½ inches thick, planed as true as possible on the upper side, the under side being cast with heavy ribs to give it rigidity at all times, especially while being planed. The ribs are covered in the brick work on which is placed, the latter being built up about 15 inches above the floor. The foundation was built up from the ground, the floor being cut away to allow the brick work to come through. A pair of castings with broad feet are bolted to this plate, as shown in the illustration. The front legs of these casings are fitted with heavy screw bolts, by which the castings can be leveled up and kept square with the plate. The top side of the casting does not directly support the load to be carried, but is supplied with a V-shaped groove in which the steel bearing bar is placed. Another point of difference between this and other tools of its class is in the width of the top edge. This is made from one-half to three-fourths of an inch wide instead of the usual one-eighth inch. The advantage of this is obvious, as the increased surface will not wear as fast or become dented or jammed as quickly as the narrower edges. The narrow edges were necessary on the old portable tools, as there was no way of getting the top surfaces in exactly the same plane. If a wide strip be tipped a little the angularity of the wide-bearing edge would bring the surface too high, hence the practice of making it narrow enough to approximate a knife edge.

Tests with such an apparatus as this will allow radial balancing



Balancing Rig for Armatures.

with sufficient accuracy for high-speed armatures, but no indication is given of the axial balancing or lack of it. An armature may be correctly balanced radial and seriously out of balance axially by having a heavy section at one end balanced by another heavy section diametrically opposite, but at the other end of the armature. In such a case the running balance would be very poor, as the two ends of the shaft would tend to run eccentrically. They will not run still, and if there is any lost motion in the bearings the shaft will follow its course as nearly as possible around the centre of rotation, making the loud chatter sometimes heard in car motors. In such cases it is necessary to shift the balance weight until a place is found for it where it will allow the shaft to run still and smooth. A test for running balance can be made by mounting the armature in flexible bearings so that the centre of rotation can assert itself. Then, while running, the shaft can be marked with a piece of chalk in exactly the same manner as an eccentric piece is marked in a chuck. The "high" point in the shaft can be located, and the balance weight replaced to suit the new condition.

Slow Speed Dynamos.

At Olten-Aarburg, in Switzerland, there is a water-power plant with dynamos direct-connected to turbines, and running at a speed of 28.5 revolutions per minute. Each unit develops 300 horsepower.

Incandescent Lighting at 25 Cycles Per Second.

When the Niagara Falls Power Company decided in 1891 to use a two-phase alternating current of 25 cycles, it was with the idea that this was the best practical form in which to generate their supply of electricity for the power purposes to which most of it was to be applied, and that what little was needed for lighting could easily be regenerated if necessary.

Notwithstanding the general belief among electric-light men that current at 25 cycles was useless for this purpose, three 50-kw transformers were installed in the power house to provide current at 112 volts for lighting the switchboard structure, the wheel pit, the offices and draughting rooms in the building, and for heating purposes.

Whatever flickering there may be with low candle-power lamps at this frequency, no trouble at all has been experienced with 16-cp lamps. No flickering has been noticed by the employees of the power company, who have been using this light during the last two years.

Even in finer work the same statement applies. Perhaps no class of men have their eyes more severely tried than draughtsmen. But even among the company's draughtsmen it was found that the threatened flickering had not been noticed.

It should be stated, however, that 32 and 50-cp lamps are commonly used here on account of the great amount of light required. But 16-cp lamps are in common use about the office in various places, notably at the telephone desk, which is situated in a dark corner of the main lower hallway.

So satisfied is the Niagara Falls Power Company with the present system of lighting their office building and power house that they have recently installed a set of transformers at the village of Echota, to illuminate it by Niagara power.

Echota is an industrial village built by the Niagara Development Company. It is built on the company's land, within the limits of Niagara Falls, at a convenient distance from the power district, and is intended to furnish suitable homes for the men employed in the new factories. Every detail tending to the comfort of the residents has been carefully worked out in the building of this village.

Hitherto the village has been illuminated by electricity supplied by a Westinghouse alternator, driven by a steam engine, and the plant has been taxed to its full capacity during the winter months.

When the question arose as to how the extension of the village should be lighted, it was decided to use current at 25 cycles. An argument in favor of this was the fact that the same power could be used for the pumps at the sewage disposal works, making a considerable saving in coal bills and attendance.

The distance from the station to Echota is only 7000 feet. A set of four No. 1 wires has been strung, following the Buffalo transmission line part way. From the point where it enters the village the system is put underground. Four-inch iron pipe, placed about 18 inches below the surface, conducts the wires to two small substations, centrally located. The two wires of one phase of the system are led into one station and the wires of the other phase to the other.

The buildings are neat little wooden structures, about 8 feet square and 7 feet high. In each is installed a 50-kw transformer, built by the Stanley Electric Manufacturing Company, especially for the low rate of alternations at which they are to run.

From the transformers a system of secondary mains has been laid in 4-inch iron pipe, along the alleys which pass in the rear of each row of houses. These mains consist of 0000 duplex stranded cable, of the Habirshaw "Red Core" brand. At frequent intervals along these mains have been placed circular iron junction boxes, 12 inches in diameter, by about 3 inches deep. At these boxes branches of No. 00 duplex wire are tapped in and led off in 2-inch pipes, these in turn being tapped by the service wires.

Echota has now been illuminated for several weeks from the new source of power, and perfect satisfaction seems to have been given, there being no complaint from any source. At present only the houses are being lighted, but eighteen ornamental poles have been ordered, and will soon be placed along the streets. It is proposed to put two 100-cp lamps on each pole, as it is thought that this number of lamps will thoroughly light up the streets of the village.

It will, of course, be an easy matter to extend the system as the village spreads out.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Open Armature Windings. EICHBERG. *Zeit. fuer Elek.*, Oct. 1.—A well-illustrated article on the Brush and Thomson-Houston forms of open circuit machines, leading to a description of a new system devised by him for multipolar machines; his own winding is somewhat similar to that of the Arnold, used in the Westinghouse machines. A new winding is obtained from the Brush system if the middle of the coils are connected, or from the Thomson-Houston when there are four coils at 90° instead of three at 120°; two of the latter windings can then be relatively displaced by 45° and connected in series, reducing the number of pulsations; applying the original winding to multipolar machines, such as one with four poles, eight collector segments will be required, each pair of diametrically opposite ones being connected together; the second part of every coil may be suppressed; a six-pole winding requires twelve collector segments, each three of which are connected together; two such windings relatively displaced at 45° give a winding corresponding to that on the Westinghouse arc light machine; there are eight coils, six poles and two collectors, with twelve segments each; the four brushes are interconnected; this winding differs from the Arnold in that in the latter twice two coils in parallel are connected in series, while in the former two coils connected in parallel are in series with two others in parallel, and also in series with two other coils in series.

Alternating Currents. COLARD. *Bulletin Soc. Belge d'Elec.*; noticed briefly in the Lond. *Elec. Rev.*, Oct. 8.—A summarized treatment of alternating-current machinery which the latter journal says is concise, well arranged, and sufficiently simple to be easily grasped; the treatment is analytical in character and is based on a simple sine curve. The current in the reactive circuit is deduced from the fact that the implied E. M. F. must, at each instant, be equal to the algebraic sum of the E. M. F. necessary to overcome the ohmic resistance, that necessary to balance the self-induction, and that required to balance the capacity E. M. F.; it is thought that this method is simpler than that depending on the considerations of energy, since it is easily represented geometrically. He discusses single and polyphase alternators, transformers, synchronous and induction motors. The English journal contains only a brief notice.

Duplex Magnet Winding.—Lond. *Elec.*, Oct. 8.—An illustration (too small to be of much use) of a machine for winding magnet coils by the Varley duplex method; the object of this method is to economize insulating and conducting material; a bare and a covered wire are wound side by side with sheets of insulating material separating the layers of wire; the machine winds such coils automatically.

Competitive Bids for Dynamos.—Elek. Zeit., Sept. 30.—A tabulation of eight different bids which were made for an addition to the Munich central station, giving the prices for three three-phase generators of 800 kilowatts each, an exciter and ten rotary transformers.

Smith Dynamo. SMITH. Lond. *Elec.*, Oct. 8.—A more detailed description of his pole pieces, which were recently described in an American journal.

Dynamos. GUILBERT. *L'Eclairage Elec.*, Oct. 2.—Illustrated descriptions of some recent improvements, taken from patents.

Dynamo Reversals of Polarity. WOLCOTT. *Amer. Elec.*, Oct.—The fields of a series machine may be reversed if the E. M. F. of the dynamo be suddenly reduced below the counter E. M. F. of the arcs, which will cause a current to go back through the dynamo sufficient to reverse it; when a belt breaks or suddenly flies off the driving pulley of the dynamo, reversal of polarity in a series machine is very apt to take place. He does not believe that reversals of shunt machines may occur, as stated by a writer in the preceding issue, through magnetic momentum, the existence of which is denied.

Rotary Converters. BELL. *Amer. Elec.*, Oct.—The principles of the rotary converter are described in simple language; the fundamental idea of the rotary converter is to feed into a revolving armature the same current which it would produce if running as a generator, and to let this current be commutated as usual. The application of the rotary converter to electric railway work is discussed; a comparison of the booster and rotary converter systems is illustrated by a numerical example.

POWER.

Boilers for Electric-Light Stations. ROSS. *Elek. Zeit.*, Sept. 30.—A reprint of a long paper in which he deals largely with the question of circulation. He comes to the following conclusions with reference to boilers for electric central stations: Where space will permit and with as constant a load as possible, internal firing is to be preferred to firing below the boiler; all boilers should be so built that the water should have sufficient circulation, especially over the fire box; the boiler should permit of a 50 per cent. forcing, at which however the efficiency falls; under all circumstances, even when overloaded, they should deliver absolutely dry steam; the application of economizers is to be recommended only under conditions representing the mean load; with very variable loads, and where ground is expensive, a considerable saving of heating surface can be obtained by using heat reservoirs for the time of maximum load.

Drainage Plant at Memel Delta. SILBERSTEIN. *Elek. Zeit.*, Sept. 30.—A very long, profusely illustrated description of this pumping plant, in which the three-phase system with a frequency of 100 is used.

Extensions of the Niagara Falls Power Plant. DUNLAP. *Eng. News*, Oct. 14.—An illustrated description of the extensions which are being made in the large power plant at Niagara Falls; it is accompanied by some good illustrations.

Reinfelden.—El'ty, Oct. 13.—A reprint of a very short article on this plant, descriptions of which have been referred to frequently in the *Digest.*

TRACTION.

Accumulator Traction in Hanover.—Lond. *Elec. Rev*, Oct. 8.—Brief data concerning the experiments with the mixed trolley and accumulator systems which have been made in Hanover. After very careful comparisons the directors of that line concluded that after taking everything into consideration they favored the accumulator system; the cost of maintenance for 1896 was determined with great exactitude and was found be 28.8 cents per mile, or $11.50 per month per car, which includes the cost of renewing the plates; when compared with the cost of maintaining the overhead conductor and its accessories it was found that the additional cost of the accumulator system was only very slight; they therefore decided to use the accumulator system on the whole line as soon as the change can be carried out.

Tests with Accumulator Traction.—Elek. Zeit., Sept. 30.—A note stating that a trial was recently made in Berlin with a car having Guelcher accumulators; the weight of the car, with four axles, was 12.5 tons and the weight of the battery 1200 kg; a charge would carry the car 15 to 20km.

Jungfrau Railway. BERTHIER. *Rev. Gén. des Sciences*, Sept. 30.—A short article, giving a description with some data, of this mountain railway. *L'Eclairage Elec.*, Oct. 2, also contains a short article with data. The latter journal also contains the list of the prizes which have been awarded for plans and parts of this road.

Mechanical Traction.—L'Eclairage Elec., Oct. 2.—Some comparative data giving the cost of installation and operation of omnibuses drawn by horses and the Scotte steam system, which has been in use for a short time near Paris.

Underground Railway at Budapest.—L'Elec., Oct. 2.—The beginning of an illustrated description of this underground railway.

Lausanne.—L'Eclairage Elec., Oct. 2.—Some official data showing the operation of the electric railway system in that city.

Philadelphia. GUNTON and LOMAS. Lond. *Elec. Rev.*, Oct. 8.—An illustrated description of the power houses of the Traction Company.

Electric Towage on Canals.—Lond. *Engineering*, Oct. 8.—In this continuation, an illustrated description is given of a vessel which combines all the modifications suggested by experience; some figures are also given showing the economy in working, which has been clearly proved with a company which used five ordinary chain-hauled tugs and three of the electromagnetic kind.

Motor Car. ELIESON system. Lond. *Elec. Rev.*, Oct. 8.—A brief description of this car, which has been in use in London. With two passengers it weighs 15 cwt.; the armature has two windings which are connected in series or parallel, according to the speed desired; the power is transmitted from the armature to the driving wheels by means of a chain which is so arranged as to allow for slippage on one side in turning corners, thus doing away with the differential gear; it has thirty Lamina accumulators which run for 30 miles with one charge at a speed of 8 to 10 miles per hour.

Motor Carriages in France.—L'Energie Elec., Sept. 1.—Very brief descriptions of a number of heavy vehicles, such as omnibuses and those for merchandise, with weights from 1 to 12 tons; ten of these were recently exhibited at a meeting of an association; almost all use other sources of power than electrical energy. The Lond. *Elec. Rev.*, Oct. 8, gives a similar but briefer abstract of the report.

Economy in Electric Car Control. Cravath. *Elty*, Oct. 6.—*West. Elec.*, Oct. 9; *Elec. Rev.*, Oct. 13.—A reprint of a paper read before the Chicago Electrical Association. He discusses the question of the proper use of the controller—that is, the general question of the rapid or slow acceleration (a similar article by the same author was abstracted in the *Digest*, Sept. 11). After pointing out the chances for increasing the economy of operation by greater attention to the handling of the controller, he discusses the various losses involved in starting; curves for a quick and slow acceleration are shown; the conditions in the two cases being the same, the energy required for the quick acceleration and slow maximum speed is shown to be lower; the theoretical ideal would be to accelerate and stop cars in an infinitely short space of time, as that would require the least maximum speed, but this cannot be applied directly in practice, as sources of loss arise with quick acceleration; while the latter is desirable, there is a limit beyond which losses will arise and motormen are constantly overstepping this limit; theoretically the amount of energy to bring a car to a given speed is the same whether the start is made quickly or slowly, but practical conditions modify the case; he shows where the losses would be. He recommends that the full use should be made of the series combination of the motors; the controller should, however, not be moved too slowly, any more than too quickly; cars should be allowed to drift as much as possible; the less the energy destroyed in the brake shoes the more economically is the car operated. Quick starting also means a larger power plant. He refers to some tests made, and gives some of the data, including those of Knox (see *Digest*, Sept. 11); in a number of cases considerable economy was shown by proper handling; men using the highest starting currents do not necessarily get the quickest and most efficient acceleration, the contrary often being the case; the controller should be handled so as to give as simple an acceleration curve as possible; the motorman should pause after each notch long enough to let the car run nearly up to the corresponding speed, especially in going from the series to the multiple notch; he should never accelerate up to full speed when no time is to be gained by doing so; there is nothing gained by applying the brakes gradually. He recommends keeping comparative records of the efficiency of each motorman.

Recent Tests of Acceleration and Braking.—Eng. News, Oct. 14.—An editorial article discussing recent tests and giving curves and data. Recent tests in Chicago showed that 64 per cent. of the power was expended in accelerating the trains; with street railways the percentage is still greater on account of the frequent stops. The curves for stopping an ordinary car are given; it takes much more power to increase the car speed from 10 to 15 miles per hour than from rest to 5 miles per hour; an electric motor, however, exerts more power when the speed increases, thus making the acceleration curve nearly a straight line. Acceleration curves are given comparing an elevated steam locomotive with a cable car; the question of adhesion is discussed; the pull of a locomotive is about one-quarter of the weight of its drivers. The recent tests of the General Electric Company are discussed and the curve given, together with the data. A table is given showing the tests of acceleration of passenger railway trains with various motors, including a number of steam lines, the acceleration speed and distances for successive periods of ten seconds being given; starting curves of different cars and trains in elevated and suburban service are also given, showing the advantage of electric traction over that by steam locomotives; the latter is very ineffective for a few seconds at starting; in the first ten seconds 16 miles an hour was reached by an electric elevated train, whereas but six miles an hour was attained by steam elevated train; other interesting comparisons are given. The importance of rapid braking is pointed out; an electric brake is mentioned which makes a quicker stop than the air brakes in use at present; the pressure on the brake shoes should be a variable one, greatest at the moment of application, and least at stopping.

The Battle of the Motive Powers.—St. Ry. Jour., Oct.—An editorial on the different advantages and disadvantages of the several systems of motive power for street railways now in use. The cable system is considered efficient and economical for a heavy volume of business along routes of great traffic density, and it is not impossible that under certain circumstances it may have a genuine economy over electric power. Electric cars are preferred by the public, however, and for other reasons also the cable system has undoubtedly seen its best days. The conduit system, in spite of its large cost, has the great advantage of unobtrusiveness and the cost of repairs in Washington and New York have been smaller perhaps than would have been the case with an overhead construction of the same capacity. The surface-contact system has a possible future, but it has not been tested in practice to a sufficient extent to warrant a confident prediction as to its valne. The third-rail system affords a tolerably obvious scheme of electric-power distribution for places where rights of way are possessed by an operating company and trespassing can be prevented, but even under these circumstances it is not advisable to increase the potentia above 500 volts; the chief advantage of this system over steam locomotives is in the rapid acceleration in speed possible, as the steam locomotive is by no means inefficient or excessively wasteful. There is a call for independently propelled cars, and compressed air has a possibility of success in this direction, although it is hardly expected that it will replace electricity in many of the places in which the latter is at present pre-eminent. There are also possibilities for the use of storage batteries on cars if improvements are made reducing the weight.

Electricity as a Motive Power for the Suburban Railway Service of New England. Short. *St. Ry. Jour.*, Oct.—A long, careful discussion of the possibilities and advantages of equipping the suburban railway service of Boston, now operated with steam locomotives, with electric power. A hypothetical electric road 25 miles in length is discussed, to operate on a time table representing the average Boston suburban service of to-day. With sixteen motor cars the coal consumption per day for this line would be 13.05 tons, or 25.2 tons less than the steam line required. The labor cost for operating would be $67.50 per day against $63.75 for the steam road. The cost of equipping such a line would be $426,000, without deducting the sale value of the locomotives. As the train service would be increased more than 50 per cent., an increase in gross receipts of 1 1-4 per cent. on the investment seems certain, and a much larger gain highly probable.

Distribution of Street Railway Mileage and Capitalization in America.—St. Ry. Journal, Oct.—A short article accompanied by a large table giving by States and motive powers the mileage and number of cars of the street railways of this country; the capital stock and funded debt, total per mile of track and per capita, are also given. The figures are for 1896 and 1897. This is probably the most complete summary of the kind published. The total mileage of electric railways in the United States is 13,765, and the total number of lines 953; the total mileage of all street railways is 15,718.

Trolley Freight Service. Dunlap. *West. Elec.*, Oct. 16.—A brief description of the road between Youngstown and Lewiston in Niagara County, which is used largely for transportation of fruit to the steam railroad lines. A motor car is used to draw the freight cars; it has a single truck with a 7-foot base and weighs seven tons; it has two motors of 50 horse-power each, which are wound for a high tractive effort; the car can pull several loaded freight cars on a level.

Engines for Electric-Railway Power Stations. Emery. *St. Ry. Jour.*, Oct.—The author first discusses the requirements for engines for electric-railway power stations, points out some common failures, and gives the general principles of proportioning engines; the original Corliss engine and six modern types of this form of machine are described. The article is well illustrated.

Train Acceleration and Braking. Potter. *St. Ry. Jour.*, Oct.—A series of tests recently undertaken by the author on the relation between tractive effort and watt hours per ton, and shows the advantages of rapid acceleration. The article is accompanied by diagrams and tables of data.

Dynagraph Car for Street Railways.—Eng. News, Oct. 14.—A well-illustrated description showing the construction and details of a test car which is in successful use on one of the Chicago lines for measuring and recording automatically high and low joints, defects in gauge, defects in rail level and draw-bar pull; it has been in use for some time. It is in the form of a truck with six wheels, and contains the various recording apparatus.

Railway Motor Design. Wiener. *Amer. Elec.*, Oct.—The principal conditions to be fulfilled in the design of a railway motor are given and the methods of carrying them out in practice are described in detail. Simple formulas are given to calculate the motor speed for a given car velocity, and the horizontal effort and capacity of a motor equipment for given conditions; numerical examples are calculated to show the application of the formulas.

Construction of Street-Railway Tracks.—Eng. News, Oct. 14.—A description, with a full-page plate of illustrations, of the track construction used in Minneapolis, on which cast-welded joints are used; the description is taken from a recent paper by Cappelen before the American Society of Municipal Improvements.

English Girder Rails.—Eng. News, Oct. 14.—A brief illustrated description of the one used on the Bristol street railway, in England.

Repair of Electric-Railway Apparatus.—Amer. Elec., Oct.—A diagram of the winding of the new Walker motor is given, and the repairing of defects in the armature is described in detail.

The Electric Railways of the Niagara River Region.—St. Ry. Jour., Oct.—A résumé of the growth and industrial development of the region around Buffalo and Niagara Falls and its electric-railway systems. The general effect of electric operation on the region is first discussed, and is accompanied by four maps showing the city system of Buffalo at five year periods since 1880, together with diagram showing the increase in assessed valuations during the same period, of six districts into which the city has been divided. Following this is a technical description of the fourteen electric lines operating between Buffalo and Lake Ontario. The article is quite long and is profusely and very well illustrated.

Street Railway System of Sydney, N. S. W.—St. Ry. Jour., Oct.—This

-ity has a population of 450,000, and has at present 67 miles of steam dummy line, 9 miles of cable road, and 3 1-2 miles of electric road. The system is owned by the Government, which has recently decided to equip the entire system with the overhead trolley. The station will contain four 850-kw direct-connected units; three storage-battery feeder stations will also be installed, and a storage battery regulating plant will be placed in the power station; a high carbon rail is used, laid on cement sub-construction with wooden block paving.

Motor Carriages in 1895. FITZGERALD. *Elec. Rev.*, Oct. 13.—A reprint of the article noticed in the *Digest*, Oct. 9.

New York State Street Railway Association.—St. Ry. Jour., Oct.—A full reprint of all the papers, addresses and proceedings, including also the discussions of the papers.

Pennsylvania State Street Railway Association.—St. Ry. Jour., Oct.—A brief account of the sixth annual meeting at Allentown; only very brief abstracts of the papers are given.

Decade of Electric Railway Development. CLARK. *Elec. Rev.*, Sept. 22, *Elec. Eng.*, Sept. 23; *West. Elec.*, Oct. 2; *St. Ry. Jour.*, Oct.—A reprint of the New York State Street Railway Association paper, which was abstracted in THE ELECTRICAL WORLD, Sept. 18.

Municipal Ownership and Operation of Street Railways. VREELAND. *West. Elec.*, Sept. 25; *St. Ry. Jour.*, Oct.—A reprint in full of the New York State Street Railway Association paper which was given in abstract in THE ELECTRICAL WORLD, Sept. 18.

Facts and Fancies of Railroads. COLE. *St. Ry. Jour.*, Oct.—A reprint in full of the New York State Street Railway Association paper which was noticed in THE ELECTRICAL WORLD, Sept. 18.

Construction and Maintenance of Car Bodies and Trucks. DUNNING. *West. Elec.*, Oct. 9, *El'ty*, Oct. 13, *St. Ry. Jour.*, Oct.—A reprint of the paper read at the New York State Street Railway Association. It is a short paper in which he gives practical directions of a general character.

Influence of Accurate Measurements Upon Economic Operations. HASKINS. *West. Elec.*, Sept. 25, *El'ty*, Sept. 29, *Elec. Eng.*, Sept. 30, *Elec. Rev.*, Oct. 6, and *St. Ry. Jour.*, Oct.—A reprint in full of the New York State Street Railway Association paper which was abstracted in THE ELECTRICAL WORLD, Sept. 25.

How Can We Increase the Efficiency of Our Employees? WHEATLEY. *West. Elec.*, Oct. 16; *St. Ry. Jour.*, Oct.—A reprint, in full, of the New York State Street Railway Association paper which was abstracted in THE ELECTRICAL WORLD, Sept. 18.

Advantages of Up-to-Date Street Railway Service. ROSSITER. *West. Elec.*, Sept. 25; *Elec. Rev.*, Oct. 13; *St. Ry. Jour.*, Oct.—A reprint, in full in the two former, and in part in the latter journal, of the paper read before the New York State Street Railway Association which was abstracted in THE ELECTRICAL WORLD, Sept. 18.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Free Incandescent Lamps.—Lond. *Lightning*, Oct. 7.—A continuation of the discussion of Gibbings' paper (see *Digest*, last week). Walker failed to see the advantage of allowing such a discount in lamps; complaints of bad lights were easily dealt with, and were not worth the trouble to be obviated by this system; the practical difficulties in carrying out the system in a place like London are great. Stearn (lamp manufacturer) praised the method; the consumer as a rule cannot test his lamps, and his interests are therefore looked after better than he could do himself; lamp manufacturers will not complain of such a system, but the local dealers would not be benefited. Proctor thinks the system would be a great blessing to both the consumer and the supplier, as most of the complaints are due to the use of bad or old lamps; if the prime object is to get the accounts paid promptly, however, the method is rather extravagant, which he shows by an example; he recommends cutting off consumers to insure prompt payment.

Central Stations in Germany. LUX. *Zeit. f. Beleucht.*, Sept. 30.—The first part of a series of general articles on central stations in Germany; the present one contains tables of some of the chief statistics for the past three years; the discussion is general in character, as distinguished from descriptions of the stations.

Central Stations in Austria.—Zeit. fuer Elek., Oct. 1.—An extract from an official report, giving information about the operation of some of the central stations and installations in Austria for the year 1896; data is also given for the telegraph and telephone industry.

Oxford System.—Lond. *Elec. Rev.*, Oct. 8.—A reprint of the report of Kennedy which was referred to in the *Digest*, Sept. 25.

Hammersmith.—Lond. *Elec.*, Oct. 8.—A long, illustrated description of this station (see *Digest*, last week).

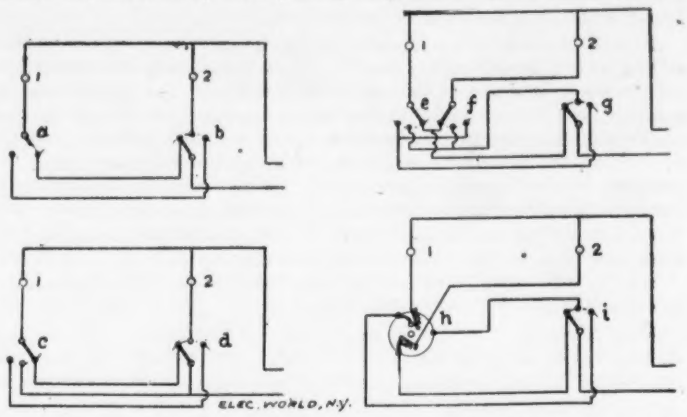
Three-Phase Switchboards. RAYMOND. *Amer. Elec.*, Oct.—He describes the evolution of three-phase switchboards in the station of the Baltic (Conn.) Power Company. Two synchronizing arrangements are described and practical information given concerning the switching in and out of motors and generators in parallel.

Three-Phase Switchboards, Strassburg Central Station.—Amer. Elec., Oct.—Drawings and description of the switchboards at the three-phase station at Strassburg, Germany, described in the September issue.

Vienna.—West. Elec., Oct. 16.—Some statistics taken from the official report recently noticed in the *Digest*.

WIRES, WIRING AND CONDUITS.

Switches for Two Lamps.—Zeit. f. Beleucht., Sept. 30.—Descriptions of several systems of switches and wiring for two lamps, either of which is to be turned off or on by either of the two switches. Four methods are described, as shown by the adjoining diagrams. Fig. 1 is the simplest arrangement; lamp 1 can be turned off or on by either of the two switches, but lamp 2 can be turned on or off only by switch *b*. In Fig. 2 lamp 1 can be operated by either of the two switches, but lamp 2 only by the switch *d*; both lamps, however, can be lighted simultaneously, if lamp 1 is turned on, by switch *c*. In Fig. 3 either of the lamps can be operated by either of the switches or can be lighted by one and extinguished by the other, or both lamps can be burning at the same time. In Fig. 4 the double switch in Fig. 3 is combined into one, and the arrangement differs from Fig. 3 in that both lamps cannot be turned on at the same time.



Wiring Rules.—Lond. *Lightning*, Oct. 7.—A brief interview with Crompton, who was largely concerned with the preparation of the new Institution rules; he replies to the recent criticisms, and emphasizes the fact that the rules were intended to lay down a minimum limit to ensure safe and good work, and to be a guide which did not throw all the responsibility on the inspector.

Fuses vs. Circuit Breakers. CUTLER, HENSHAW, DOWNES. *Amer. Elec.*, Oct.—Cutler maintains that the function of the ideal circuit breaker is to protect electrical apparatus from two main destructive effects of abnormal electrical currents, namely, the heating effect and the inductive effect. He gives a result of a test of a circuit breaker designed on these principles; with 60 amperes, normal current, the circuit breaker did not open at all; it withstood 65 amperes for 15 seconds, 70 amperes for 9 seconds, 80 amperes for 3 seconds, 90 amperes for 1 1-2 seconds, and with 100 amperes opened the circuit in a fraction of a second. Henshaw considers that the critical point in the design of a circuit-protective device is to obtain the exact degree of "sluggishness of blowing," neither more nor less, and that this end can be accomplished more accurately with the fuse type than with the circuit breaker. He believes, however, that the fuse and circuit breaker have each a distinctive value under different conditions. Downes discusses the defects of the ordinary fuse, the two principal ones of which are stated to be a variable melting point and the tendency to destructive arcing on heavy overload or short circuit. He considers that these objections are overcome by enclosing the fuse within a tube and surrounding it with a suitable, finely divided material, leaving an air space at the centre of the tube within the filling; a fuse constructed on these principles is described in detail and data given of a test made with it.

Switch Combination. FISH. *Amer. Elec.*, Oct.—A combination switch is described, whereby lamps may be turned on and off from one, two or three switches; the circuit also includes a burglar-alarm switch which is made to close automatically in connection with a regular burglar-alarm system, and prevents lights to be turned on or off by the regular switches.

Three-Wire Secondary Wiring. THORNE. *Amer. Elec.*, Oct.—Practical directions are given for installing an alternating-current three-wire secondary system of distribution, using the ordinary two-wire transformers.

Apparatus for Indicating a Broken Wire.—Elec. Eng., Oct. 7.—An illustrated description of the apparatus described in the *Digest*, Sept. 25.

Interior Wiring.—Amer. Elec., Oct.—Directions are given for testing an installation for acceptance.

ELECTRO-PHYSICS AND MAGNETISM.

Light Propagated in a Dielectric Normal to the Lines of Force. BRACE. (Univ. Nebraska) *Phil. Mag.*, Oct.—An article describing experiments to determine the effect upon polarized light of a transparent medium in a magnetic field; no general conclusions are given.

Steady Motion of an Electrified Ellipsoid. SEARLE. *Phil. Mag.*, Oct.—A reprint of the Physical Society paper which was noticed in the *Digest*, July 17.

Propagation of Waves Along Connected Systems of Similar Bodies. RAY-

LEIGH. *Phil. Mag.*, Oct.—A highly mathematical article dealing with waves in general.

Cathode Rays. J. J. THOMSON. *Phil. Mag.*, Oct.—A long communication describing experiments, a number of which were described before by him in a paper which was abstracted in the *Digest*, May 29 and June 5.

Properties of Different Forms of Energy. VASCHY. *L'Eclairage Elec.*, Oct. 2.—An article discussing energy in general, in its different forms and its transformation from one form into another.

Magnetic Polarity of the Human Body.—Cosmos, Oct. 2.—A short article stating that a certain person was found to have a magnetic effect on a galvanometer needle; when completely undressed and placed near the galvanometer it was found that when he turned on a vertical axis the needle was deflected first in one direction, and after a gradual change in the other; the experiment was repeated a number of times, always with the same result; this was repeated with a dozen other persons, but without the slightest effect on the needle; the experiment was also tried on Murani, an Italian professor, and it was found that his body was magnetic, the breast being a north pole and the back a south pole. It is suggested that those who experiment with delicate galvanometers should first test whether they are not themselves a magnet.

Short Waves of Terrestrial Magnetism. ESCHENHAGEN. Lond. *Elec.*, Oct. 8; abstracted from the *Berl. Berichte*, p. 678.—Since his last communication on this subject he succeeded in obtaining sixty records of elementary earth magnetic waves of periods varying from 15 to 30 seconds; with his apparatus he recorded truly elementary waves.

Inductance and Lag.—Amer. Elec., Oct.—An editorial advancing a theory of inductance based upon the assumption that a coil carrying a variable current may be considered in the light of a dynamo, generating an E. M. F. opposing that supplied at the binding post when the variable current is rising in value, and an E. M. F. assisting the impressed E. M. F. when the current is falling in value; the impressed E. M F. is made up of two components, inductive E. M. F. and free E. M. F., the latter being that required to overcome the ohmic resistance of the coil; at certain points of a period the inductive E. M. F. has the same value as the impressed E. M. F., at which points therefore the free E. M. F., being the vector difference of the above, is zero; since the current follows the free E. M. F. in a circuit containing inductance, it cannot have its zero value at the same time as the impressed E. M. F., and consequently the two are out of phase, the former lagging behind the latter.

Inductance and Capacity.—Amer. Elec., Oct.—The current installment of the "Lessons" gives a simple method of viewing inductance and capacity in alternating-current circuits; an inductive circuit is considered to be a generator of E. M. F. the same as a dynamo, and the effects of capacity are explained as due to the unbalancing of the E. M. F. between the two sides of a condenser. A change of E. M. F. causes a condenser to be unbalanced, and if the E. M. F. is increasing its capacity is increased, and a current flows into it in the same direction as the line current, thereby adding to the line current; when the line current is decreasing, the condenser is unbalanced in the opposite direction and a current tends to be sent forth, opposing the line current.

Electrified Matter. TYLER. *El'ty*, Oct. 13.—The conclusion of his long serial, the first part of which was noticed in the *Digest*, July 17. In this serial he gives his views on electrical phenomena, which he believes are due solely and simply to a "lessening of cohesion" of the molecules of "its substance"; he claims that there is no such thing as electricity. There is also an editorial discussion in which it is questioned whether the endeavor to teach the science along these lines would give better results than the present methods.

Glow in a High Frequency Field. EBERT and WEIDEMANN. *El'ty*, Oct. 13.—A brief abstract of the article noticed in the *Digest*, Oct. 9.

LECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Chlorates. BECKER. *L'Eclairage Elec.*, Oct. 2.—A brief account of the present state of this industry.

Electrolytic Refining of Nickel. FOERSTER. Lond. *Elec.*, Oct. 8.—A translation in part of the article which was noticed in the *Digest*, last week.

E. M. F. and Partition Equilibrium—Lond. *Elec. Rev.*, Oct. 8.—A brief summary of the recent discussion between Bucherer and Luther.

Electro-Chemical Society. MULLER. *L'Eclairage Elec.*, Oct. 2.—The beginning of an account, with extracts of the papers, of the recent meeting of the German society. (German reprints of all the papers have already been noticed in the *Digest.*)

Thermo-Electric Batteries. ANTHONY. REED. *Amer. Elec.*, Oct.—Anthony contends that in the Jacques cell the oxygen forced in through the positive electrode impregnates the liquid adjacent to that electrode, and constitutes an element analogous to the depolarizing elements of two fluid cells; he insists that the energy, oxygen plus the positive ion, is there within the cell, and that, with the energy, carbon plus the negative ion, is sufficient to supply all the energy to be accounted for. Reed denies that oxygen can, by combining with the positive ion of the electrolyte, furnish exactly the energy required for the decomposition of the electrolyte; the free oxygen bubbling through the electrolyte of the Jacques cell can have no more effect directly on the electric circuit than copper filings thrown into a plating bath would have on the transferred copper from the anode. The copper filings in a plating bath may act chemically on an acid that has been set free by the current at the anode, but such reactions have no connection with the electric current, are purely chemical and evolve no energy except heat.

Percarbonate of Potassium.—Eng. & Min. Jour., Oct. 9.—An abridged translation of the paper of Van Hansen, which was noticed in the *Digest*, May 22 and Oct. 31, 1896; see also July 31.

Electrolytic Etching.—Elec. Rev. and El'ty, Oct. 13.—A reprint of the article abstracted in the *Digest*, Oct. 2, describing the Rieder process; the former journal also contains the illustration.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Sensibility of the Telephone and Its Use for Measuring. FRANKE. *Elek. Zeit.*, Sept. 30 and Oct. 7.—A long article describing very extensive researches, in which he measured the sensitiveness of telephones, with special reference to their use to replace the galvanometer. Owing to the large number of factors involved, numerous tests had to be made; the sensitiveness of the telephone is of interest both theoretically and practically, and such researches as these will enable the sensitiveness to be increased; in his present tests he endeavored to eliminate the sources of error in previous measurements; he determined the sensitiveness as a function of the frequency, the thickness of the membrane, and the strength of the field, and he defines the sensitiveness as the reciprocal of that current which still produces an audible sound. Errors are easily introduced by the capacity of resistance coils, and he thinks that it is due to these that the extremely small values were obtained by other observers for the minimum currents; the method he used was to diminish the voltage and to eliminate the effect of the time constant; this he does by means of the Wheatstone bridge, the telephone being used in place of the galvanometer and in series with the make and break produced by a revolving disc, by means of which the frequency was easily determined; as part of the bridge was composed of a slide-wire resistance very small differences of potential could be produced, and the current is then calculated from the bridge resistances; between two points on the bridge wire no audible sounds were produced. He also measured the self-induction of the telephones by the Rimington method; for a single-pole Bell instrument of a resistance of 128 3 ohms he obtained a coefficient of 0.062 quadrants. The results are given in curves and tables; the curves show that for every thickness of diaphragm a maximum of sensitiveness was obtained, and for a frequency which probably corresponds with the natural period of vibration of the diaphragm; several lesser maxima were also found for the harmonic frequencies; he shows how with such researches the effect of every factor can be determined, and he believes the sensitiveness of the present telephones could be considerably increased by such investigations. The effects of the strength of the poles were also measured with three thicknesses of diaphragm, the magnet being first completely demagnetized and then gradually magnetized again; all of the curves of sensitiveness rise to a maximum and then remain horizontal no matter how much the magnetization was increased; a test of theoretical interest was made with a diaphragm of silver, with which it was possible to reproduce sound and even speech, the action being due to the effects of the currents produced in the diaphragm. Besides being of use in measuring the resistance of electrolytes, he shows that the telephone can be used to great advantage to replace the galvanometer in measurements with zero methods; he describes a vibrator for use in such cases. When used for resistance measurements the self-induction and capacity of the bridge resistance have no effect on the measurement, as when the current in the bridge wire is zero the capacity and self-induction in the branches is eliminated; the minimum of audibility is always very sharply defined. He describes a method for measuring insulation resistances by means of a zero method in which a known and an unknown resistance are in series, the telephone being connected to that junction and the other pole being moved along a slide-wire resistance with a separate battery, the two circuits, however, being connected by connecting one pair of similar poles of the two batteries. The same rules regarding the best resistance of the galvanometer apply also to the telephone. He concludes that the telephone is a good substitute for the mirror galvanometer in many cases.

Theory and Application of the Phase Meter. TEICHMUELLER. *Elek. Zeit.*, Sept. 23 and Oct. 7.—A continuation of his long article (see *Digest*, Oct. 2). In order to experiment with the instrument he constructed one which he describes and illustrates; it is a mirror instrument, with suspended coils. He describes at considerable length an application to a constant frequency and constant phase shifting, and concludes, with the aid of mathematical deductions, that with a form of wave not following the sine law the deflection will be proportional to the square of the current or voltage as long as the relations of the amplitudes are not changed, that is, so long as the curve form remains the same; the instrument under such circumstances can therefore be calibrated by determining the reduction factor; when the curve form changes this proportion will no longer remain true; this fact can be made use of to determine whether the curve form changes or not; he therefore concludes that the phase meter cannot be used in the case, which is the general one, in which the wave form can change; it can, however, be used in practice with sufficient accuracy, and independently of the curve form, when applied as a voltmeter; the article is to be continued.

Measurement of the Electric Field of the Atmosphere. DE FOUVIELLE. *Cosmos*, Sept. 25.—A short article on the recent balloon ascension of Lecadet, which was made to measure the electric field of the atmosphere at different altitudes. Deductions made from the results obtained point to the probability that at a height of about 6000 meters there would be found a neutral layer where the electric field is zero; also that the potential of the earth would be 160,000 volts; the rapidity of the decrease is very great in the neighborhood of the surface of the earth.

Cable Testing. TOBLER. Lond. *Elec. Rev.*, Oct. 8.—A description of what he considers a very good method, described by Lord Kelvin twenty-two years ago, for testing insulation resistance by loss of charge, a method which the present writer thinks is almost unknown and has never been described in text books; the original description is reproduced. Tobler then describes an application of this method to a condenser of moderately good insulation, and concludes that the great advantage of this test over the ordinary method lies in the fact that the deflection which represents the loss of charge can be exactly reproduced, while in the other method two deflections, which differ widely, have to be compared. The method does not admit of being described in abstract.

Capacity of Long Cables. YOUNG. Lond. *Elec.*, Oct. 8.—Supplementary to his discussion with Dearlove concerning the correction in the Gott method of testing long cables, he gives a few results of experiments with the Muirhead method, from which he shows that the corrected values vary very widely with the earthing period, while those arrived at by calculation are much more consistent.

Clark Cell. FISHER. Lond. *Elec.*, Oct. 8.—A reply to the recent criticism of his remarks; it contains nothing of importance. He remarks that the secondary cell is a fairly accurate standard of E. M. F.; after being relieved of its initial voltage and connected in series with 100 to 200 ohms the drop is only 5 per cent. during a run of 600 to 800 hours; he has no faith at all in the Daniell cell as a standard.

Induction Coil Break. COULON. *Cosmos*, Sept. 18.—A description of a form of interrupter which he has been using for a year with good results. It is a modification of the Foucault apparatus, in which a stream of water is constantly flowing over the surface of the mercury, thus carrying off any impurities formed. It is made of an old sewing machine, in which the needle is replaced by a platinum wire which at each movement dips into the mercury.

Construction of an Electrical Testing Set.—Amer. Elec., Oct.—The first part of an article, with working drawings, describing the construction of a Wheatstone bridge fitted with a reflecting galvanometer; the brass work is the subject of this installment.

Testing Dynamos.—Amer. Elec., Oct.—The stray power method of testing dynamos is described. The article appears to contain errors.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Efficiency of Telephone Translators. REDING. *Jour. Télégraphique*, Sept. 25.—The beginning of an article describing tests made to determine the electrical efficiency of translators (induction coils or transformers) used in telephony. The only other tests of the kind were those made by Wietlisbach in 1896 (and noticed in the *Digest* at the time), but the method used was open to criticism and the measurements were limited to 250 oscillations, while in the telephone the oscillations due to the human voice are from 200 to 1000 per second; the present author therefore repeated the tests very carefully. The best translators are those which when acting as receivers give a maximum effect in the secondary as compared with the primary, and the relation of these two determine the efficiency; he also measured the difference of phase and the loss of energy in magnetization. A number of different forms were tested, illustrations of which are given. No conclusions are drawn in this portion.

Sensitiveness of the Telephone. FRANKE. *Elek. Zeit.*, Sept. 30 and Oct. 7.—See abstract under "Measurements."

Use of the Telephone.—L'Elec., Oct. 2.—A table giving the number of communications per subscriber and the number of subscribers in each of a number of European and Asiatic countries, the statistics being based on the year 1895. From these it appears that in Japan the number of calls per subscriber is greatest, being 4499, and this is followed by Austria, Germany, Belgium and France. The number of apparatus in service is greatest in Germany, namely, 132,137, followed by Sweden, France, Switzerland and Austria. Among the large countries the number of calls per subscriber is least in Switzerland, which is thought to be due to the system of charging. Great Britain is not included in the list.

Telegraphy without Wires.—Cosmos, Sept. 18.—A description from *Revista Maritima* of the recent experiments of Marconi at Spezzia; this article is reprinted in *L'Elec.*, Oct. 2. A brief account of these experiments were given in the *Digest* last week.

Telegraphy without Wires.—Lond. *Elec. Rev.*, Oct. 8.—A brief description of the Spezzia experiments and some brief references to the question of priority; also a brief mathematical theory of the Marconi process by Proposto.

Wireless Telegraphy.—Lond. *Elec.*, Oct. 8.—A brief quotation from a daily paper, in which J. J. Thomson stated that nearly two years ago Rutherford successfully signalled through a distance of three-quarters of a mile by means of electric waves; the land between the stations was thickly built over; he used a detector of his own invention, and not the Branley-Lodge coherer.

A Peculiar Phenomenon. LOCKWOOD. *Amer. Elec.*, Oct.—In the preceding issue a case was reported in which after a lightning discharge, the diaphragm of a telephone was found to have stamped on it the impression of the end of the core and coil underneath. Lockwood offers the explanation that the discharge, being an oscillatory one of high frequency, was first dammed back by the impedance of the core-encircling coils, and the major part of the portion carried by the wire jumped the points and passed to earth harmlessly; though the transient current produced was so weak that it did not burn out the coils, it was swift in action and surged through the telephone coil strong enough to greatly emphasize the core magnetization for an inappreciably brief instant of time; the diaphragm was thereupon violently pulled toward the core with a sharp and irresistible force, with the result stated of stamping it as though in a die.

American Telephone Practice. MILLER. *Amer. Elec.*, Oct.—Several forms of metallic circuit plugs and jacks are described, and also the Warner drop, which neither affects nor is affected by, any similar drop in its vicinity. These drops are stated to be usually wound to a resistance of 500 ohms; the impedance due to the great number of turns in the coil and the perfect magnetic circuit surrounding the same is so great, that practically no diminution in the strength of speech transmitting is felt, due to its being bridged across the two sides of the line.

Switch and Bell Circuits. SANBORN. *Amer. Elec.*, Oct.—A diagram is given for the usual multiple bell and push-button circuit, whereby all of a number of bells may be simultaneously operated from any one of a number of buttons. This method is described as being much superior to that of placing all the bells in series, with the vibrators of all but one bell thrown out.

Dynamo Bell Ringing. FRANCIS. *Amer. Elec.*, Oct.—The use of storage cells for bell ringing, the cells being switched into the bell circuit when the latter is disconnected from a dynamo circuit upon the stoppage of a machine, is criticised; in order to use storage cells the rate of charge would have to be cut down so low as to deteriorate the cells.

MISCELLANEOUS.

Danger Limit of Alternating Currents.—Elek. Zeit., Oct. 7.—An editorial describing some recent expert tests which were made because the Swiss Government considered that the 5000-volt three-phase current which was to be used on two railways under construction would be too dangerous; on these lines a 5000-volt line was to be used on the same poles with the 750-volt current in the trolley wires, and this was considered by the authorities to be dangerous. Prof. Weber made some tests, of which abstracts are given; he endeavored to find at what voltage alternating currents would be dangerous to human beings and he made the tests on himself; in one case both wires were grasped by the hands and in the other he stood on the ground and touched one of the circuits; a sort of potentiometer resistance wire was used and touched at various places; with moist hands he could stand from 10 to 50 volts and with dry hands up to 90 volts, touching both wires; with moist hands at 30 volts the arms were lamed and it was almost impossible to move the hand, the pain was intense and could be borne only five to ten seconds, but it was still possible to let go of the wires; the current through the body was 0.012 to 0.015 amperes; at 50 volts the effect was increased and it was impossible to let go of the wires; it could be endured only one to two seconds; the same was true with 90 volts and dry hands; the pain was intense. Brown (of Switzerland) repeated the tests with continuous currents, and found that the effects were about the same with double the voltage. This indicates that the voltages used in dwellings might be considered dangerous, but it could not be concluded that therefore such installations would be dangerous; it depends upon how the contact is made; a mere touch cannot be compared with grasping the bare wires. For the test in which he stood on the ground, a similar circuit with 2000 volts was used, one end of which was grounded; the ground on which he stood was moistened; these voltages proved to be nearly harmless, which is thought to be due to the insulation of the soles of the shoes; he only noticed a strong burning sensation; it was greater when standing on wet loam than on wet crushed stone; when the wires were grasped it was not possible to let go. He concludes that if the shoes are dry, even though the ground is wet, such circuits are not dangerous, if the voltage does not greatly exceed 1000.

Lightning Conductor Rules.—Lond. *Elec.*, Oct. 8.—A translation of the German rules which were noticed in the *Digest*, last week; they are also criticised editorially. The rules are very complete, but it is thought that they will probably not be followed, as the house owner makes himself liable to repair the whole water and gas pipe system of Berlin if their destruction is traceable to his conductor, provided he has made connection with these pipes.

Electric Furnaces.—Lond. *Elec. Rev.*, Oct. 8.—A very brief summary of Borchers' recent article classifying electric furnaces.

Electric Sounding Apparatus. BABCOCK. *L'Elec.*, Oct. 2.—A brief illustrated description of this system of taking deep-sea soundings, in which an electric circuit is closed by contact with the bottom.

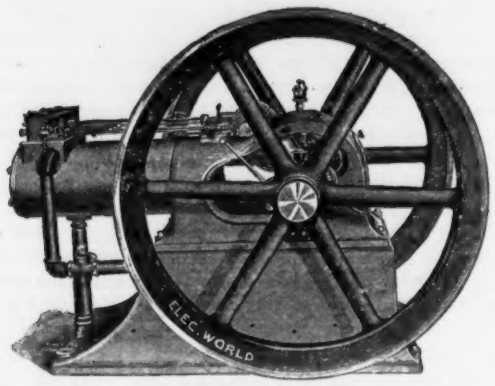
Instruction.—Elek. Zeit., Oct. 7.—A list of the lecture courses on electrical subjects for the coming winter at a number of the leading German colleges and universities.

Electric Catechism.—Amer. Elec., Oct.—The current installment shows the application of the parallelogram of force to alternating current problems.

Combined Gas and Gasoline Engine.

The engine illustrated herewith can be run with either gas or gasoline, and a change from one kind of fuel to the other can be readily made while the engine is running.

The Dayton Gas Engine & Manufacturing Company, Dayton, Ohio, the manufacturer of this engine, makes some extraordinary claims for the



Gas Engine.

machine as to its adaptability for electric-lighting service. It is stated that the variation in speed of this engine, running under full load, does not exceed 2 per cent., and that an additional load or even the whole load thrown onto the unloaded engine does not affect the speed. In evidence of this claim the company refers to several plants where these machines are running dynamos, elevators, etc. In one case, a heavily loaded elevator thrown on one of the engines carrying incandescent lights did not perceptibly affect the brilliancy of the lights.

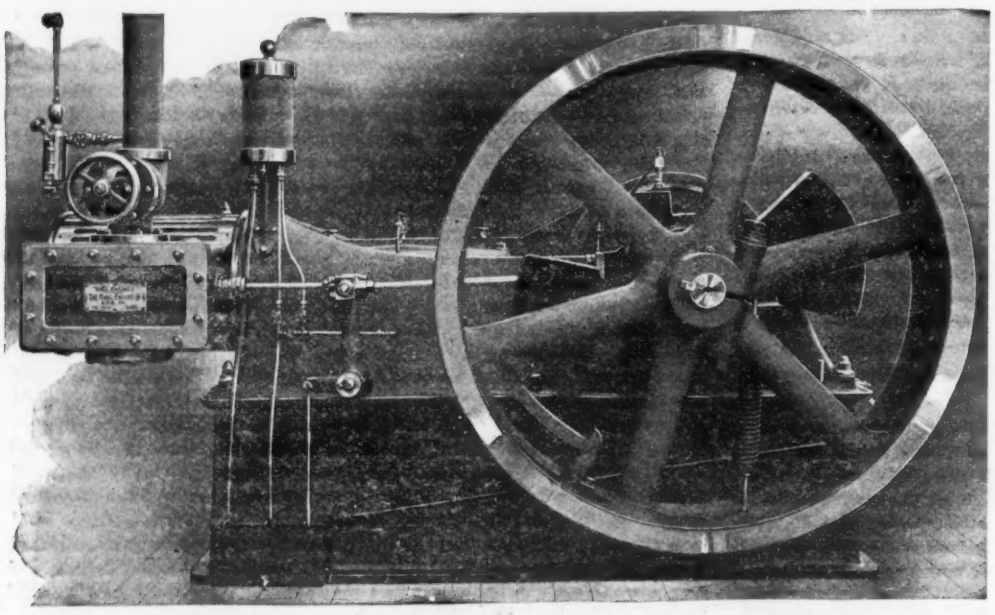
The engine appears to be very simple in construction, the valves working in a straight line without the assistance of the usual bell-crank lever and other intermediate mechanism. It presents a very attractive appearance, and the workmanship put upon it is claimed to be unsurpassed.

An Improved Single-Cylinder Engine.

Of the great variety of engines used in electric-light and railway plants throughout the country, perhaps none stands in higher esteem than the engine made by the Ball Engine Company, Erie, Pa.

This company is constantly making improvements in its engines where experience suggests, and in this line it calls attention to the single-cylinder engine which is illustrated herewith. This engine is equipped with the new Rites governor and automatic lubricating system. This governor, as is well known, utilizes a combination of inertia and centrifugal forces and not only regulates with the very highest degree of perfection, but with an extraordinarily rapid adjustment, and without any instability or racing. It also has the advantage of great simplicity, as the entire governor consists of but a single moving piece suspended upon one pivotal point, thereby reducing friction to a minimum.

The lubrication of the engine is accomplished by the use of the gravity system of supply to graduated sight feeders. This system of oiling possesses many advantages over the splash or direct forcing systems. The oil after having been distributed over the running surfaces gravitates to the bottom of the inside of the frame, whence it is led out to the front end and through an inclined pipe down to a receiving tank. Here the oil passes through one or two screens to remove any floating particles of foreign matter and is then pumped to the supply tank above the engine in a much greater quantity than is necessary to supply the engine, the surplus being carried back to the receiving tank by an overflow pipe. This arrangement insures a bountiful supply of oil to the bearings.

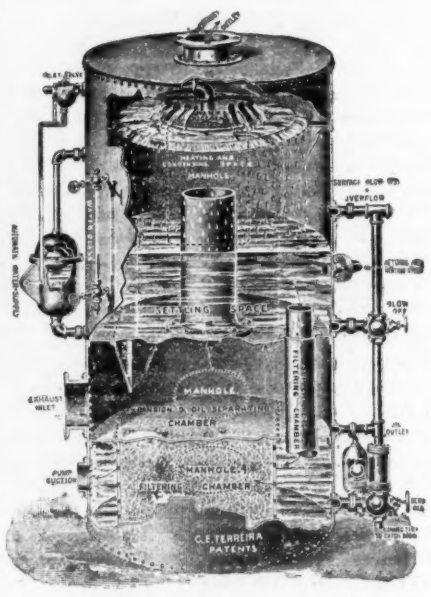


Improved Engine.

The Excelsior Feed Water Heater.

There is a prevalent idea among steam engineers that the use of feedwater heaters in which the exhaust steam is mixed with the feed water is dangerous, owing to the liability of oil being returned to the boiler. That this is not the case may be readily understood when marine practice is considered. In the enormous steam plants on shipboard, the exhaust steam is used for boiler feeding, perfect safety being assured by the use of an oil separator. With a similar oil separator or purifier, feed water can be heated by exhaust steam with safety on land. The use of an open heater as opposed to that of a pressure heater has several advantages. There are no pipes to scale up, and by reason of the intimate mixing that may be accomplished, the heater may be made much smaller than a pressure heater of the same capacity.

The Excelsior feed water heater, which is shown in the accompanying illustration, combines the functions of a heater, purifier, filter and oil separator. This heater is divided into three chambers. In the top of the upper one the cold water is received, and distributed and divided into fine streams or drops by a spreading plate. In the central chamber the exhaust steam is received behind a deflecting plate, which causes it to turn sharply around a corner and throw a large part of its oil to the floor of the chamber. The steam then rises through a central flue into the upper chamber where it is intimately mixed with the feed water, and is finally exhausted at the top of the tank. The heated feed water is taken from the upper chamber to the lower chamber, where it passes through a filtering material and thence to the feed pump. An automatic valve is arranged to control the water supply and blow-offs, and manholes are provided in all the chambers.



Sectional Perspective of Heater.

These heaters are of boiler construction throughout. Slip bolts are used on all manholes, and the cleaning door is on hinges. They are coming to be widely used in electric-lighting and street-railway plants. The Lindell Railway Company, of St. Louis, Mo., after five years' use of the heaters, has ordered two new 1000 horse-power and one 600 horse-power to add to its present equipment.

These heaters are manufactured by the Harrisburg Pipe Bending Company, whose agent in New York is Mr. J. M. Duncan, 30 Cortlandt Street.

An Astatic Recording Wattmeter.

The construction by the General Electric Company of a recording wattmeter of sufficient capacity to measure and register the total output from the generators in central railway or lighting stations met a demand created by the new conditions of electric practice. The character of this demand may be gauged by the fact that a recording wattmeter which three years ago would have been regarded as of enormous capacity is to-day considered small; meters of 10,000 amperes are now commonly called for, while inquiries have been made for sizes registering as high as 16,000 amperes. Measurement of these heavy capacities precluded the use of any form of wound meter field, and the Thomson Recording Wattmeter had necessarily to be modified. While on the majority of switchboards an astatic wattmeter is not necessary, there exist cases in which the best metering results could not be obtained without one; and that total station output meters might be applicable alike to all switchboards, whether within heavy projected fields or not, the G-2 meter has been designed and is manufactured in an absolutely astatic form.

In the G-2 meter the field is a single straight bar of forged copper, above and below which are placed two armatures arranged astatically and having a common commutator. The damping device is also double and astatic—the polarities of the upper and lower group of damping magnets being opposite. The damping mechanism being enclosed within an iron shielding box, any stray leakage lines of an unbalancing character are prevented from entering. The G-2 meter is so independent of local or stray influences that it may be installed directly in front of the very heaviest buses without the introduction of any inaccuracy.

The entire meter is held in position upon the switchboard by two studs, which form at once the electrical connections and the mechanical support of the instrument. These pass through the board and are bolted to the bus bar by binding nuts with large contact surfaces.

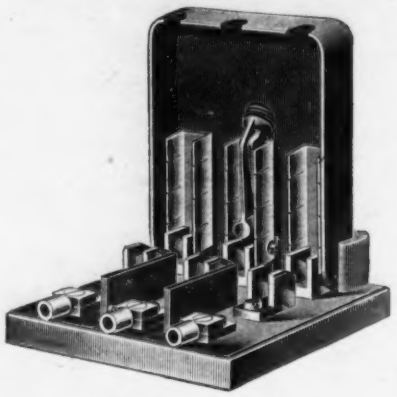
The cover is of beveled glass, set in a polished brass frame fastened to the board.

A New Service Switch.

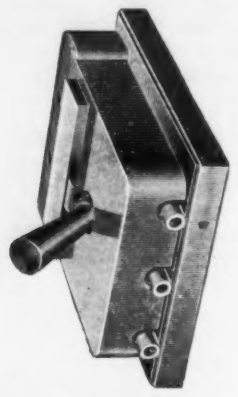
The accompanying illustrations represent a new three-pole quick-break switch, in open and closed positions, just placed on the market by the Albert & J. M. Anderson Manufacturing Company, Boston, Mass. The switch is provided with fuse terminals and screens, and is designed for use as a cut-out where electric light wires enter a building. When the switch is closed the entire switch, with fuses, is covered by an insulating covering made of Ætna insulating material.

Should the electric light company desire at any time to discontinue the supply of current to a customer, provision is made so that after removing the fuses the closed switch may be sealed up with the company's seal. No current can then be taken except by breaking the seal.

In the construction of this switch careful attention has been given to good material, design and workmanship. The action of the switch is positive; the construction simple and the insulation of the highest quality.



SERVICE SWITCH OPEN.



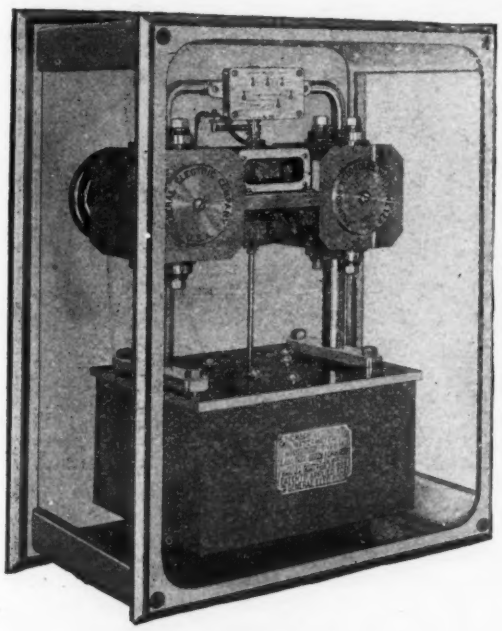
SERVICE SWITCH CLOSED.

New Microphone.

A new microphone is being put on the market by Messrs. Whitman & Couch, of 196 Summer Street, Boston, Mass., who for the past few years have been solely identified with the Ericsson Swedish Microphone.

This instrument they now offer to the trade is of superior merit in construction, appearance and efficiency, embodying all the good points of the Swedish microphone and embracing several new features, which, it is claimed, are a decided advantage.

Messrs. Whitman & Couch have long felt that the excessive duty of 35 per cent., and now 45 per cent., which had to be paid on the Swedish microphones and telephones represented good money which ought to go into the article itself, and not into Uncle Sam's treasury, and while they have had great success in introducing and making popular the Swedish microphone in the United States, they have not lost sight of the fact that man's works offer room for improvement. They have therefore worked on the basis of producing a microphone which would sustain their reputation in the telephone field, and permit them to offer an article of home manufacture equal to any transmitter in the world. The firm makes a full line of telephone apparatus, and is prepared to equip exchanges complete. Two styles of its instruments are illustrated herewith.



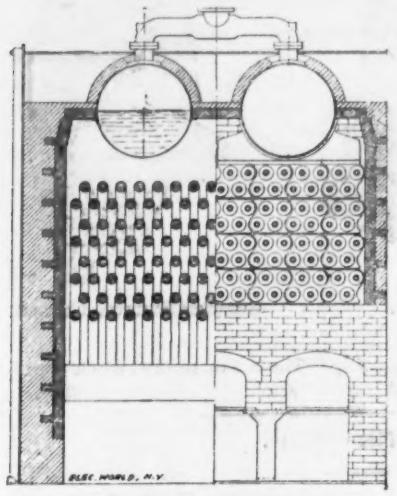
ASTATIC RECORDING WATTMETER.

WALL SET.

PORTABLE SET.

The "Standard" Boiler.

A water-tube boiler that combines many ingenious features of design and high-grade workmanship is made by the Standard Boiler Company, whose offices are in the Marquette Building, Chicago. This boiler is made with inclined water tubes of conventional design and cylindrical steam and water drums. One of the main features is the construction of the



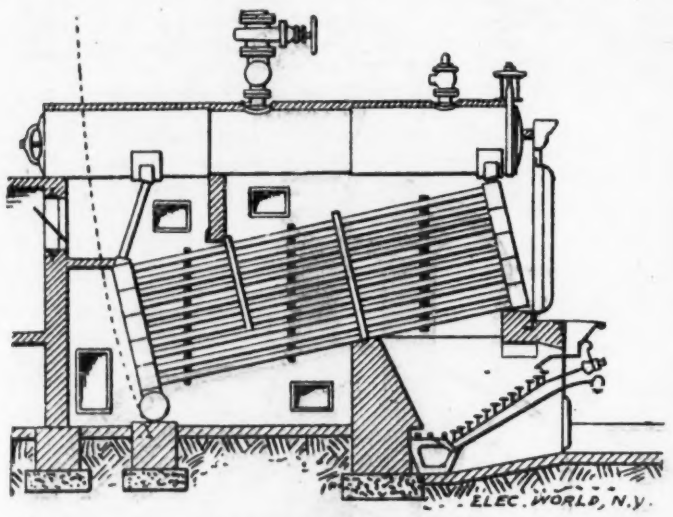
Front Elevation.

headers, which are subdivided into small sections, each section of sufficient size for four tubes. The headers are made of open-hearth steel and are interconnected by short nipples of heavy tubing expanded into bored holes. The hand-hole plates for cleaning are ground in place, iron to iron. The steam and water drums are made of the best brand of open-hearth steel, stamped 60,000 pounds T. S. All seams are hydraulically riveted; longitudinal seams are double riveted.

The whole boiler is suspended from steel cross beams and is thus free to expand and contract independently of the brick setting. The latter can be removed at any time if necessary, without disturbing the boiler.

The steam drum is made sufficiently large to give ample disengaging surface, which is necessary for the production of dry steam. About 1 square foot of surface is given for every two horse-power and and also about 1 cubic foot of steam space.

The same company also makes a water purifier for use in localities where pure water for feeding purposes cannot be had. In this purifier the water on its way to the boiler falls on a series of pans in a fine spray, where it is



Longitudinal Section.

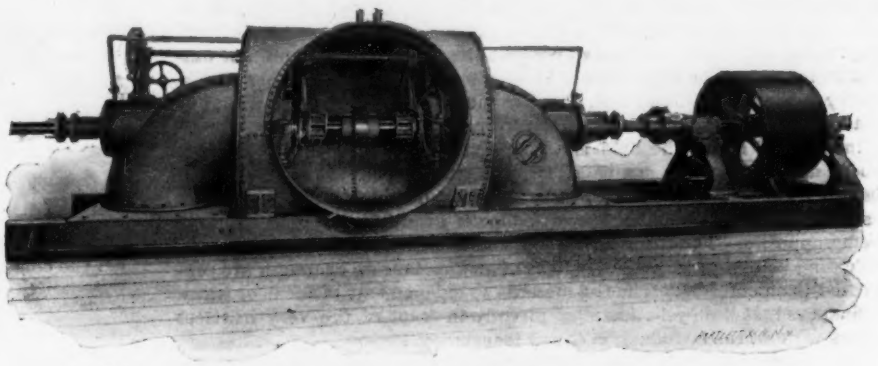
instantly heated to the boiler temperature. Impurities drop into the mud chamber in the form of a fine sludge.

The New American Turbine.

The rapid development of water powers throughout the country has brought to the front an industry that, a few years ago, was comparatively little known and appreciated. We refer to the manufacture of water turbines.

Among the principal manufacturers of this class of machines in this country at the present time is the Dayton Globe Iron Works, Dayton, Ohio. This concern produces a wheel that is meeting with considerable favor in many localities where water power is available, and its wheels are found in use in some of the most important and largest electric generating plants in the Western States. The New American turbine, which is the name of the wheel manufactured by the Dayton Company, is said to possess several points of superiority. It is said to give the highest average efficiency from whole to half water, and to give the greatest power for a given diameter. Steadiness of motion is also one of its chief and most important characteristics, and next to this is its strength and durability. The wheel is regulated by a governor which is said to give the utmost satisfaction in practical operation, and effect economy in the use of water.

The Dayton Company furnished the city of Marquette, Mich., with a pair of 22-inch New American turbines to operate under an 80-foot head.



22-Inch American Turbines.

These wheels are represented in the accompanying illustration. They are encased in an iron flume and rest on steel I-beams. They transmit their power by means of the rope-drive sheave shown at the right of the illustration.

Tests of American wheels at the Holyoke water power plant show that the efficiency of the wheel gradually increases from whole water to a point between .8 and .9 of the full discharge, reaching a high efficiency at this degree (with a seven-eighths gate) and maintaining a remarkably high percentage with all degrees of gate.

The Manufacture of Storage Batteries.

In no place is the manufacture of storage batteries conducted with such approved methods or on such an elaborate scale as in the factories of the

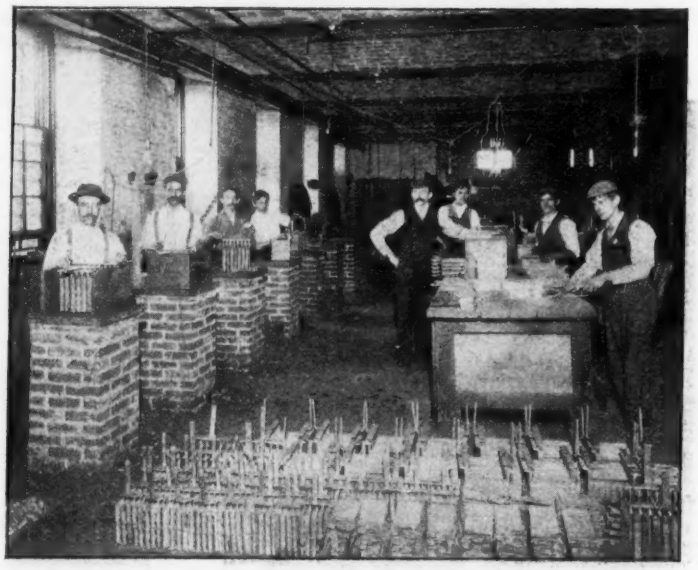


Fig. 1.—Chloride Casting Room.

Electric Storage Battery Company, near Germantown Junction, Philadelphia. The process of manufacture is in its entirety quite simple, but many of its details are exceedingly interesting and methods of the highest ingenuity are employed throughout. In this factory the processes for making the positive and negative plates are entirely different.

The positive and negative plates are made on different principles; the negative being a spongy, crystallized lead reduced from chloride of lead, which is said to be the ideal form of negative plate. Fig. 1 shows the chloride of lead casting department.

The active material in the positive plate is applied in the form of a ribbon made into spiral buttons, presenting a very large surface and rendering the plates capable of very excessive rates of discharge. These plates are formed in a very large room constructed for the purpose, illustrated in

Fig. 3. The conducting supports of both plates are cast under very heavy pressure, making a very perfect and dense casting.

After the plates have been made, the first process they undergo is the addition of connecting lugs or bracketing pieces which hold together the several similar plates of one cell. This department is called the assembling room, and is illustrated in Fig. 2. Pure hydrogen is generated in large cast-iron tanks by the usual sulphuric acid and zinc-clipping process, and fed at some pressure to duplex blow-pipes, which also receive air from a Root blower. The resultant jet is almost colorless, 5 or 6 inches long, and is projected with considerable force from the orifice of the blow-pipe, so that when lead is melted by its means the melted metal may be blown about. The workmen engaged in this trade acquire in time great skill in handling the flame and are able to produce surprisingly accurate results by its means. The forming of the positive plates takes place in a building separated from the main factory. Here large lead-lined tanks filled with acidulated water are prepared for the immersion of the positive plates. In

FIG. 2.—ASSEMBLING ROOM.

these tanks ordinary sheet lead is used as the negative terminal, the negative plate, as has already been explained, being completed in its saturating tanks without electrolytic action, except as will be noted later. The requirements of a building where are handled large quantities of acidulated water and acid reeking with the fumes of hydrogen and the spray which arises from storage cells in active ebullition, necessitate special construction. The girders of the roof are covered with many layers of lead paint, practically a lead coating. The walls of the room are of tile and the floor of asphaltum.

Current of various pressures is supplied from large generating sets in the basement of the main factory. The negative plates are here also subjected to a few hours' electrolytic treatment to remove any traces of chlorine which may not have been entirely eliminated by the soaking process.

In a room on one of the upper floors of the factory, called the Lead Tank Room, the cells for the reception of larger sizes of batteries are manufactured. These are made of sound ash about 1 1-4 inches thick, the parts being accurately dovetailed together, a very ingenious machine

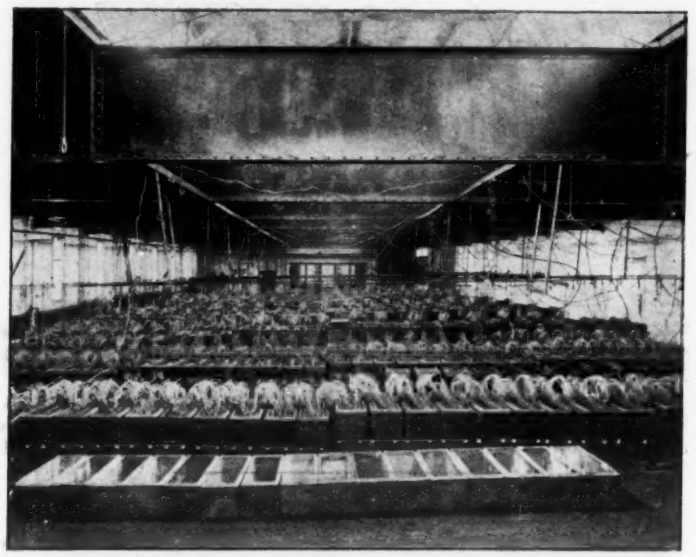


FIG. 3.—FORMING ROOM.

for this purpose being in operation in the wood-working department. The boxes thus formed are painted on the outside with an asphaltum composition and lead lined within with sheet lead burned together, no solder being used anywhere either about the batteries or their containing boxes. In mounting a large battery the plates are suspended by glass rods instead of the india rubber gaskets formerly used for this purpose. It has been found that, in the manufacture of the largest sizes of plates, it is better not to attempt the construction of the whole plate at one operation; so it is usual in these cells to make the plate in two parts, one row of buttons or squares, as the case may be, in the upper grid being omitted and their place occupied by the solid lead in order to increase the conductivity of the plate.

So substantial are the plates now manufactured that they are put together for shipment in crates holding 600 pounds each.

The Electric Storage Battery Company has carried the system of manufacture of its product to a high degree of perfection, and its 250 employees are so trained that the maximum output is secured with the greatest ease.

Surface-Contact Street Railway System.

The demand for a commercially practical system of surface-contact electric traction has existed since electric traction was first introduced, but such a system had to come to its appointed place after the overhead and underground contact systems. Various schemes have been evolved in the past which have either been discarded as impracticable or appeared before the demand for them has become acute enough to encourage their development.

The experiments with a system of this class, extending over many months, have been carried out upon a stretch of the track which forms part of the factory-tramway system of the General Electric Company's works, at

FIG. 1.—SECTION OF TRACK.

Schenectady, N. Y. The car shown in the illustration (Fig. 1) is a simple factory tram, to which the controller, motor and storage battery equipment have been fitted. It may be said here that the General Electric Company is now engaged in changing over to the surface-contact system the entire trolley-tramway system in its yards.

The only live portions of the G. E. surface contact system on the street surface are the contact plates immediately beneath the car. These contact plates are placed in parallel rows between the two rails of the track and are set alternately. As seen in the illustration (Fig. 1) the positive or communicating discs are on the right, the negative or discharging discs are on the left, one of each between two of the others. Each positive contact plate is made alive by the operation of an automatic magnetic switch, which, instead of being placed in immediate juxtaposition with its plate or opposite it outside the track, is placed in a manhole with a large number of others, each connected to its own respective plate. Through each negative plate is performed the double duty of closing the contact in the switch, which "cuts in" the positive plate and of receiving the return current from the motors.

The operation of this system will be understood from the diagram, Fig. 2. A' A^2 are the negative plates, B, B' and B^2, the positive contact plates, placed equal distances apart, a little less than one half the over-all length of the shoe. C, C', C^2 represents the automatic magnetic switches and D, D' and D^2 their armature or contact makers. F is the positive or collecting shoe, E the negative or return shoe and C the track return. H and

K are switches which form part of the controller, the latter connecting in or cutting out the cells of a small storage battery, which is used only to energize the coil of the first switch through the plate over which the car passes in starting. After the armature of the first switch has been raised into contact and the line current has completed its circuit, the battery is cut out by the forward movement of the controller handle. In the diagram the car is to move to the right and all the magnetic switches are open. The handle of the controller is turned to the first notch and switches H and K are closed. Current from the battery flows through a small portion of the motor resistance to the shoe, thence to contact plate A and the coil C' completing the circuit to the ground. The coil C', thus energized, raises the armature D', closes the circuit through the automatic switch and the line circuit, completes its path through the motors and through the greater part of the motor-starting resistance shown by the arrows through the positive plate B and shoe F. Part of the return circuit goes to the storage cells, which are kept constantly charged, and part through shoe

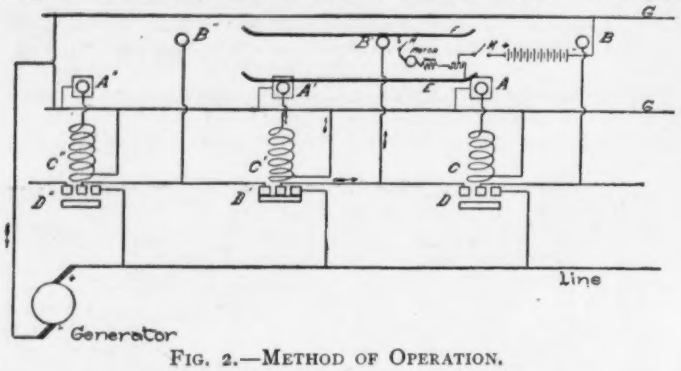


Fig. 2.—Method of Operation.

E, negative contact plate A' and coil C' to ground, keeping the latter energized and the automatic switch closed so long as the shoe remains on contact plate A'. Moving the controller handle forward from the first notch to the second notch opens the switch K, cuts out the battery and sends all the return current through the coil C'. The shoes E and F in the diagram are a little longer than the distance between contact plates. Thus when the car moves forward slightly the shoe will be in contact with the two contact plates A and A' and the return circuit will divide, half going through coil C' and half through coil C, energizing both and closing the armatures in the switches D' and D. The car moves forward and the shoe passes beyond the contact plate A'. The circuit in the coil C' is broken, the armature D' drops, cutting out entirely positive plate B', leaving it dead but allowing B' still to receive current through the closed switch at

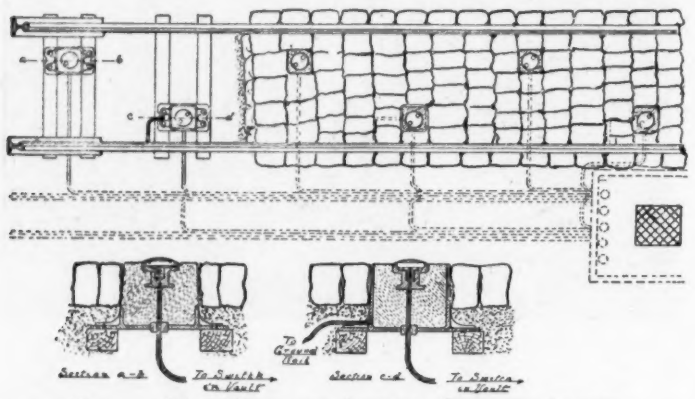


Fig. 3.—Plan View and Sections Through Plates.

D. Shoe F moving forward then makes contact with plate B before it leaves plate B' and the current is uninterrupted in its flow.

The automatic magnetic switch has been designed to endure under the severest strains and to act with such uninterrupted precision that the working of the system may not be impaired. Mechanically the switch is simple, strong and durable, with all chances of derangement reduced to a minimum.

If the leakage is great an arc is likely to form when the armature of the switch drops, and so long as this is held the contact plate in the street would remain alive, while the arc would burn the switch. It is not practicable to allow the armature to drop far enough to break the arc, and to extinguish it the magnetic-blow-out principle is brought into play. By this means the retention of this arc is impossible. But there is also the possibility of another arc forming in case of accidental ground on one of the leads to the positive contact plate or if the forward switch fails to close when the handle of the controller is on the first notch, giving a path to ground through the battery. This is also taken care of by the magnetic blow-out.

The form of the contact plates is shown in Fig. 3. They are first set in iron boxes and then surrounded by insulation. The contact plates consist of two parts, a wearing piece screwed into a support and held by a spring washer. This wearing piece can be removed readily without disturbing the support. The standard shoe is 13 feet long. Its shape and suspension are shown in Fig. 5, the ends being curved upward slightly to prevent catching. The shoes are supported from the axles and have a slight upward and downward movement to allow for any irregularities in the height of the contact plates.

The automatic magnetic switches are grouped in manholes, where inspection can readily be effected. Fig. 4 shows a group of these temporarily arranged for exhibition. Each manhole will contain about twenty switches,

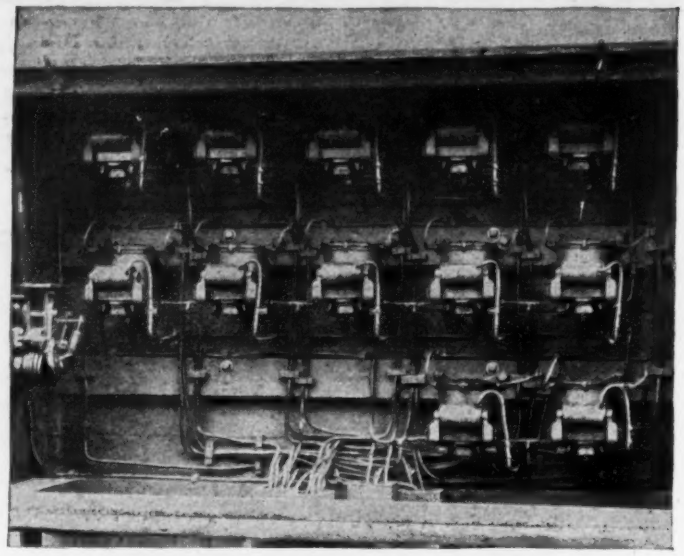


Fig. 4.—Automatic Magnetic Switches.

and the wires from the contact plates to them will be protected in similar manner to underground wires for any other purpose.

Grouping the switches in manholes renders the working part of the system easily accessible for inspection.

The battery on a car consists of ten cells with normal capacity of 50 ampere-hours at 5 amperes. It is equal to all emergencies, being called into requisition only momentarily, while being charged the balance of the time the controller handle is on the first notch.

A close examination of the design and operation of this system will show that it possesses many striking advantages. The operation of the automatic switches is perfect under all conditions, as the full line voltage can be secured to close them and they open by gravity. There is no possible chance of the contact remaining electrified after the car has passed, as by

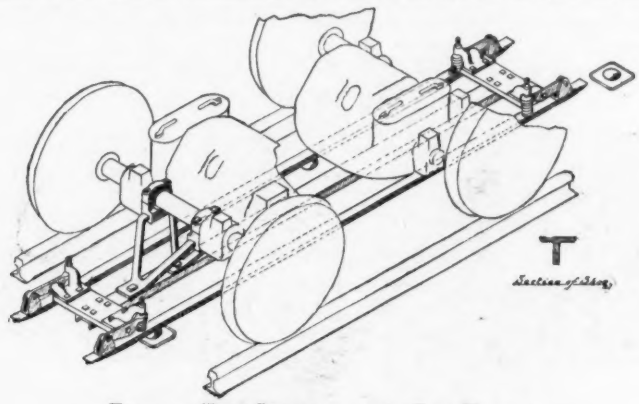


Fig. 5.—The Shoes on the Car Truck.

the use of the blow-out on the switch and the switch itself, which opens as soon as the current is shut off, all danger and trouble due to live contacts is eliminated.

In the town of Monte Carlo, in the principality of Monaco, this system is being laid down by the Cie. Française Thomson-Houston, over a distance of about 3 miles. It is expected that this will be in operation very shortly.

An Electrolytic Generator.

A notable addition to the already extensive electrical plant of the Niagara Falls Hydraulic Power & Manufacturing Company, in the power house at the foot of the cliff, at Niagara Falls, N. Y., will shortly be made in the form of a General Electric electrolytic generator, which, it is said, will be the largest of its kind ever constructed.

This machine will have fourteen poles and will run at 257 revolutions, giving an output of 5000 amperes at 175 volts, or a capacity of 875 kilowatts. It will be of the latest type and will be directly connected to the water-wheel shaft. It will be provided with a special panel switchboard with full Form K equipment of instruments necessary to handle a current of 5000 amperes. The General Electric Company is already well represented in the power house of the Niagara Falls Hydraulic & Manufacturing Company.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, October 18, 1897

ELECTRICAL STOCKS were all decidedly weaker last week and quotations declined without any exception. Edison Electric Illuminating of New York is 3 points lower than the last quotation. Electric Storage Battery is minus about the same amount. General Electric closed with a net loss of 1⅞ points. The number of shares of this stock sold during the week was 18,266, and the fluctuation of price was confined within a margin of 3 points. The highest point reached was 35⅜, and the lowest, 32½. The two Westinghouse issues are lower.

TELEGRAPH AND TELEPHONE.—Weakness characterized this list and lower quotations are the rule. Bell Telephone lost 2 points, closing at 255 bid, and Erie Telephone is on the minus side of the market, as well as New England Telephone, the latter dropping off 3 points as compared with the last quotation. Western Union shows a net loss of 1½ points. The quotations fluctuated between 89¾, the highest point of the week, and 87⅛, the lowest, the closing price being 87¼. The number of shares of Western Union sold during the week amounted to 28,583.

	Par.	Bid.	Asked.
ELECTRICAL STOCKS.			
Chicago Edison Company	100	126	..
Edison Electric Ill., New York	100	122	125
Edison Electric Ill., Brooklyn	100	..	110
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill., Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	27¾	28¼
Electric Storage, pref	100	29½	30
General Electric	100	33⅞	34
General Electric, pref.	100	80	84
Westinghouse Consolidated, com	50	22	..
Westinghouse Consolidated, pref	50	52	54
BONDS.			
Edison Electric Ill., New York, con. 5s	105	110½	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	100½	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	256	257
American District Telegraph	100	..	30
American Telegraph and Cable	100	88	91
Central and South American Telegraph	100	124	127
Commercial Cables	100	175	..
Erie Telephone	100	69	..
New England Telephone	100	..	130
Postal Telegraph Cable	100	99	101
Western Union Telegraph	100	87⅛	87½
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18¾	19
Brooklyn Rapid Transit	..	32¼	32½
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	75	77
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	47	48
Hestonville	100	47¾	48
Hestonville, pref	..	..	62½
New Orleans Traction	100	4	7
New Orleans Traction, pref	100	..	25
North Shore Traction	100	..	90
North Shore Traction, pref	100	..	80
Rochester Street Railway	..	17	19
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	110	..
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	92	..
West End, Boston, pref	100	101	..
Worcester Traction	100	16	18
Worcester Traction, pref	100	90	93
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	87½	..
*Buffalo Street Railway 1st con. 5s	100	109	111
Cleveland Electric Railway 1st mtge., 5s	100	102	104
*Columbus Street Railway 1st 5s	100	95	97
Rochester Street Railway 1st 5s	100	90	..
Union Railway (Huckleberry) 1st mtge. 5s	.	107	110
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

ELECTRIC TRACTIONS.—In common with the rest of the electrical stocks the traction issues were extremely dull last week, and in almost every instance where changes are noted lower prices are indicated. Columbus Street Railway stock sagged off on a decreased volume of sales. All the Brooklyn traction securities continue inactive, with fractionally changed quotations. In the railway bond list Brooklyn Rapid Transit 5s declined 3½ points.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, October 21, 1897.

MR. JAMES GILBERT HICKCOX, of the American Rheostat Company, Milwaukee, Wis., was in New York last week.

THE FOURTH ANNUAL SPORTSMEN'S EXHIBITION AND BICYCLE SHOW will be held at Madison Square Garden from January 14 to January 22, 1898. Among the electrical novelties that will be shown on this occasion will be electric launches and bicycle appliances of various kinds.

THE ELECTRIC-LIGHT PLANT on Ward's Island was consumed by fire on the evening of October 19. The island is used by the city for hospitals the insane. The isolated plant supplied light for the entire island and heat for the asylum buildings. The plant caught fire at about 7 P. M., and as a result the whole island was in darkness.

WORK ON THE BRIDGE TROLLEY.—The extension of the Brooklyn trolley systems over the New York & Brooklyn Bridge has been pushed forward vigorously. The north roadway has been closed to vehicle traffic, and a clear field given for the workmen. Temporary trolley wires have been extended over the new track to enable supply cars to be run to the end of the line.

MR. JOHN VAN HORNE, for many years first vice-president of the Western Union Telegraph Company, resigned that position a few days ago. Mr. Thomas F. Clarke, formerly assistant to President T. T. Eckert, of the same company, was elected to fill the vacancy temporarily. Mr. Clarke was also elected vice-president of the Gold & Stock Telegraph Company to fill the vacancy caused by the resignation of Mr. Van Horne, who formerly occupied the position.

THE ELECTRIC ARC LIGHT COMPANY has removed its offices from 687-689 Broadway, to the American Tract Society Building, 150 Nassau Street. Mr. William C. Hubbard has been elected secretary and general sales agent of the company and will have charge of the new office. Mr. Hubbard is a pioneer in the enclosed-arc lamp business, having been associated with Prof. L. B. Marks from the first experiments in this line, and assisted largely in the introduction of the "Pioneer" arc lamp.

SOUTHERN NOTES.

WASHINGTON, D. C., Oct. 18, 1897.

A DIVIDEND of $1 per share, payable on October 25, has been declared by the Chesapeake & Potomac Telephone Company.

THE SOUTH SIDE TELEPHONE COMPANY, of Richmond, Va., has made application to the Husting's Court for a charter.

A TELEPHONE EXCHANGE will be established at Snow Hill, N. C., Mr. Powell, of the Kinston Telephone Company, having organized a company for the purpose.

AN ELECTRIC RAILWAY from Wilkesboro to Taylorsville, N. C., a distance of 20 miles, is one of the future possibilities. The proposed line is entirely feasible, and, it is stated, would pay a handsome dividend to any company operating the same.

THE CAPITAL TRACTION COMPANY has awarded to the General Electric Company, of Schenectady, N. Y., the contract for the electrical equipment of its road, which was formerly operated by cable power, and lately rendered inoperative by the burning of the power house in this city. The construction work will be in the hands of Mr. Edward Saxton, who states that he expects to have part of the road in operation on the electric system by November 1 next.

THE RICHMOND CITY COUNCIL will consider a recommendation for the appointment of a Committee on Electricity, to have charge of all electrical matters in the City of Richmond. The committee will pass on all franchises involving the use of electricity, and will have the power to inspect, or to have inspected, all electrical appliances, and to order faulty construction to be repaired. This inspection is to be made by the superintendent of fire alarm and police telegraphs.

AN IMPROVED ELECTRIC LAMP is called for in this city. In the annual estimate for the expenses of the District of Columbia for the fiscal year ending June 30, 1898, it is recommended that the use of arc lamps on residence streets should be avoided because they are annoying to many people in the summer months by their brilliancy and on account of the insects attracted thereby. It is suggested that $3000 of the annual appropriation be set aside for the experimental lighting with improved lamps.

A DEPARTMENT OF ELECTRICAL CONTROL is much needed in the administration of electrical matters in the District. The creation of such a department has been repeatedly recommended, and the recommendation is again renewed in the annual estimate for the expenses of the District during the next year. At the present time the duties of supervising electrical wires and the enforcement of laws relating thereto, are performed by officials of the various departments in addition to their regular duties.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., October 18, 1897.

THE NEW MATHIESON ALKALI WORKS at Niagara Falls, which is to manufacture caustic soda and bleaching power on a large scale, by electricity, was opened for business last week.

NEW GENERATOR RECEIVED.—The first of the five additional 5000-hp generators was received last week at the Niagara tunnel power house from the Westinghouse Electric & Manufacturing Company, Pittsburg. It has already been tested, and found to be in good working condition. The power generated by it will be distributed partly in Niagara Falls and partly in Buffalo.

THE NEW ALADDIN TRAINS, so called, that are to be put on the Lake Shore Railway between Buffalo and Chicago, besides being the finest in the world, are to be lighted by electricity generated by a dynamo in the baggage car, the dynamo being run by its own small steam plant. The system includes two incandescent lights in each berth, so that passengers can read while lying down.

THE ACTUAL AFFILIATION between the old street railway company and the Traction Company, of Buffalo, which has all along been suspected, appears to be verified by the production at the Niagara Street power house of the former of the current used for running the cars of the latter. This power, however, will be discontinued when there is enough to be had from the Niagara tunnel line.

THE HORSELESS CARRIAGE lately received on trial has attracted much attention. It came from the Pope Bicycle Works at Hartford, and is to be followed by several more, if it behaves properly, as it appears to do. It is in the form of a covered buggy for two persons,and will run about six hours from a single charge of the storage battery placed under the seat. It weights 1320 pounds and cost $3000.

A SECOND TROLLEY LINE between Buffalo and Niagara Falls is the subject of all sorts of rumors. It is morally certain that George P. Smith, of Tonawanda, with a franchise for most of the distance, and a line half way, will succeed somehow in building a line. The latest idea is that the Buffalo Traction Company, aided by Boston capital, will step in soon. The City of Niagara Falls has so far refused right of way, but a new route is now proposed and a further effort is to be made at once to secure the franchise.

THE CATARACT POWER & CONDUIT COMPANY, the Buffalo distributing agent of Niagara tunnel power, has begun the construction of a transformer and distributing house at Ohio and Indiana Streets. It will be used to accommodate the elevators and other power plants in the dock district. The pressure of the current from the tunnel is 11,000 volts, and it will be reduced here to 2200. The company has so far contracted for 6000 horse-power in Buffalo, and will have it on the spot some time during the winter. The line of conduits from the tunnel to the new transformer house is complete, and a cable is going down in the Buffalo River for connection with the elevators and other power-using plants on the farther side. Contracts have been made in that district for furnishing the power to the Union Dry Dock Company, beside the Great Northern and Electric elevators. Among other applicants for power are the Export and Marine elevators. In order to make sure of enough electric power for all contracts the Conduit Company has increased the capacity of the plant on Elk Street, which will be kept running till the tunnel power is ready, only 900 horse-power being delivered from the tunnel at present. Two 2700-kw three-phase generators have been put in. They are to go to Minneapolis when no longer needed here, and until that time will supply about 5000 horse-power.

PITTSBURG NOTES.

PITTSBURG, Pa., October 16, 1897.

DIVIDEND DECLARED.—The Central District & Printing Telegraph Company has declared a dividend of 2 per cent., payable on October 28, to stockholders of record October 23.

NO MUNICIPAL PLANT FOR NORTH BRADDOCK.—For some months the Borough Council of North Braddock has been considering the question of arc lights for the streets. The advisability of establishing a municipal electric-lighting plant was carefully considered from every point of view. A proposition from the Braddock Gas & Light Company for lighting the streets was also under consideration, and after thorough investigation it was decided to be for the best interests of the borough to accept the Braddock Company's proposal rather than to attempt the operation of a municipal plant. Accordingly, a ten-year contract was executed with the Braddock Gas & Light Company for fifty or more arc lights of 2000-candle power. To provide for this additional load the Braddock Company has installed a new 125-light Brush arc generator, and service under the new contract was begun last week.

LAST WEEK OF THE EXPOSITION.—This is the last week of what has proved to be one of the most successful expositions ever held in Pittsburg. In the electrical display the leading part, as usual, has been taken by the Westinghouse Electric & Manufacturing Company, whose enormous sign, made of incandescent lamps, covers the entire east end wall of the gallery in the main building. In Machinery Hall the Company's exhibit includes an alternator driven by a Westinghouse compound engine, a 50-hp street railway motor, and one or two small rotary transformers, all in operation. In addition to these there is a complete line of minor apparatus, consisting of Shallenberger measuring instruments, fan motors, switches, etc., and the perennial copper-plated egg spinning on a plate. The adjoining space is occupied by the Westinghouse Machine Company with a display of gas engines. One of these operates a belt-driven dynamo. The perfect regulation of these engines is shown by another outfit consisting of an engine direct connected to a constant-potential incandescent lighting generator. The Bullock Electric Company exhibits two generators driven by a Dick & Church automatic engine, and a good-sized space is devoted to Otto gas engines. The general lighting of the exhibition, both arc and incandescent, is supplied by the Allegheny County Light Company.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Oct. 18, 1897.

MR. A. A. THRESHER, of the Thresher Electric Company, Dayton, Ohio, spent a day in Chicago last week.

MR. F. A. ROSS, secretary and manager of the Stromberg-Carlson Telephone Manufacturing Company, of this city, has resigned his position and severed his connection with the company.

MR. H. HILLEY has been appointed electrical inspector in the Inspection Department of the City of Chicago. Mr. Hilley is well qualified to fill this position, and his many friends will no doubt be pleased to learn of his advancement.

THE QUARANTINE REGULATIONS in the yellow fever districts in the South have had the effect of suspending the shipments of telephone equipments for Southern cities. This information was given out by the Stromberg-Carlson Telephone Manufacturing Company, of this city, which states that some of its shipments of complete equipments for Southern cities have been stopped. The company, however, is enjoying a large trade in the North Central and Northwestern States, beside a continually increasing demand for its intercommunicating telephone system and other specialties. The success with which this company is meeting is attributable to the excellence of its apparatus, both as regards its electrical and mechanical construction, as well as its freedom from the many patent claims now in question.

THE UNDERGROUND WATER PIPES in some sections of this city are in danger of being eaten away by stray electric currents from the electric railway ground returns. An examination of these pipes in different parts of the city by City Electrician Ellicott revealed such a state of affairs that unless something is done to keep the currents from being diffused through the ground it will be but a matter of a short time when every water pipe in the city will have to be replaced. Mr. Ellicott has been making a series of tests on the water pipes, and in almost every instance has found that the pipes have been affected by the stray currents and the iron corroded. He suggests that every trolley line in the city be compelled to string a copper wire underground the full length of its tracks and utilize the same as the ground return.

THE FEMALE EMPLOYEES of the Western Electric Company in this city on October 16 gave an entertainment which was very successful and well patronized. The company has provided two large rooms for the girls employed in its factory. These girls have formed a club called the Occident Club, which has now been in existence for two years. It is self-supporting and entirely managed by the girls themselves. They have fitted up the rooms, one as a library and reading room, which is also used as a room for concerts and has a seating capacity of about 500; the other, which is of the same size, has been fitted up with lunch counters and a kitchen. On Saturday, October 16, the Occident Club gave a literary and musical entertainment from 4.30 to 5:30 P. M., and from 5:30 to 6:30 furnished refreshments to those who cared to stay. The balance of the evening was spent in a social way. Over 400 attended the entertainment.

MILWAUKEE NOTES.

MILWAUKEE, Wis., Oct. 18, 1897.

AN INTERURBAN ELECTRIC RAILWAY between Oshkosh and Berlin is projected, and it is stated that Eastern capitalists are interested.

THE COUNTY COURT HOUSE wiring contract has been awarded to Messrs. Rohn & Meyer, of this city. Ironclad conduit will be used in the installation.

THE CITY AUTHORITIES OF RACINE have stopped the stringing of any more wires on the poles in the principal streets of the city, as it is claimed that the poles are already overloaded.

THE OSHKOSH HORSE-CAR LINE has been purchased by the Citizens' Traction Company for $37,000. The line will be electrically equipped and added to the present system of the Citizens' Company.

THE MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY has let the contract for the grading for the Milwaukee & Waukesha Interurban Railway. Work will be commenced at once, and finished in time for the laying of the tracks next spring.

THE WISCONSIN TELEPHONE COMPANY has given notice in Oshkosh that rates are to be advanced to those charged by the Northwestern Company, which is a local company. Rates will be increased from $12 to $13 for private residences and from $24 to $30 for business places.

THE MADISON STREET RAILWAY will be sold under foreclosure proceedings December 1 next. The order for sale was granted on petition of the New York Guaranty & Indemnity Company, which holds outstanding bonds and interest amounting to $174,412.80. The road has been in the hands of a receiver for the past year and a half.

FLY WHEEL ACCIDENT.—A large fly wheel in the Oconto electric-light plant, Oconto, Wis., burst and scattered pieces in all directions. One large piece, after demolishing a chair in which the engineer had been sitting a few minutes previous, flew out of a window and was picked up 80 feet from the building. The city was without light for two nights.

THE CITIZENS' TRACTION COMPANY, of Oshkosh, is now having some trouble with the Common Council. The Council is opposed to the Traction Company changing the power of the old line from animal to electric unless it will make certain promises. There seems to be a general feeling of distrust and dissatisfaction in the city. The Council wants iron posts put in instead of cedar, and thinks that a double track should be laid on Main Street, while the Aldermen on the South Side think that the company is not putting in as much track as that part of the city is entitled to. The deal between the horse car company and the new company has not yet been fully completed, and the management of the new company says that unless the Council withdraws its objections the road will never be purchased.

ST. LOUIS NOTES.

ST. LOUIS, Mo., October 18, 1897.

THE NEW ELECTRIC RAILWAY to connect Goshen, Ind., and Danville, Ill., is receiving some attention. A number of directors of the company will meet in Logansport, Ind., on October 20 to determine which of the two surveyed routes for the lines is the more feasible. The right of way has been secured through Indiana. A New York syndicate will furnish the capital for the construction of the line. St. Louis will become the ultimate terminal point of the road and a survey will be made at once from Danville to St. Louis.

AN APPLICATION FOR THE APPOINTMENT OF A RECEIVER for the International Electric Company has been made by Messrs. Hugh G. Ferguson and George De Lisle. The suit was brought against the International Electric Company, the American Exchange Bank, Gustave Richter and others. Mr. Ferguson alleges mismanagement of the business and other irregularities. An order was issued upon presentation of a bond of $2000 by the plaintiff to restrain the defendant corporation from disposing of its assets until further orders of the court.

THE NEW THIRD-RAIL ELECTRIC SYSTEM, invented by Mr. B. C. Seaton, is being tested at Forsythe Junction, in the suburbs of St. Louis, on the St. Louis, Kansas City & Colorado tracks. An additional rail has been laid for half a mile, and it is expected that trains propelled by electric power will be run over it this week. If results justify, the Colorado line will probably use the new system to handle its suburban traffic. It is claimed by the inventor that trains operated on this system may be run at a higher speed and at less expense than by the use of steam power.

IT IS RUMORED that the Citizens' Electric Light & Power Company and the Terminal Railroad Association are negotiating a deal whereby the former will build a large power house and supply light and power for the latter, in addition to carrying on commercial lighting. As already noted the Terminal Company has been for some time considering a scheme to substitute electricity for steam in the operation of its locomotives through the tunnel, and on all the sidings on both sides of the river. The commercial business of the Citizens' Company will conflict with the reorganized Missouri Edison Company, just as the Kinloch Telephone Company has come into direct competition with the Bell Company. The Missouri-Edison Company already has a contract with the city for lighting, and is doing a big commercial business. The contract for furnishing the power required by the Terminal Company to operate its system entirely by electricity would be of such proportions that it would give the Citizens' Company an immense advantage in competing for the city lighting. If the deal is consummated there will be a big fight. It is a significant fact that Mr. Julius Walsh is the president of both companies.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., Oct. 14, 1897.

THE CITY & SUBURBAN RAILWAY COMPANY, of Portland, Ore., has considerably increased the capacity of its electric-power station on the East Side by installing there the generators and steam plant formerly used in the Fulton station.

THE ALAMEDA COUNTY LIGHT, FUEL & POWER COMPANY is a recent California incorporation. William Clark, Philo Wells, E. S. Irwin, W. H. Payson and F. H. Busby are named as the incorporators. The capital stock is placed at $1,000,000.

MR. MACRAE, representing the Electric Storage Battery Company, Philadelphia, is in this city superintending the installation of 150 chloride cells in the building of the San Francisco Gas & Electric Company. The storage plant will be used on the 220-volt, three-wire system. The building and electric equipment are up to the latest practice in accumulator work.

THE MOUNT WHITNEY TELEPHONE COMPANY, which has 200 miles of long-distance lines connecting Visalia, Tulare, Porterville and Bakersfield, Cal., it is reported has filed a petition in insolvency. The small telephone systems projected in this State have been unfavorably affected by the Berliner decision, which caused capitalists to withdraw their support instead of fighting as they are doing in the East.

THE DUNCAN ENCLOSED ARC-LAMPS are now being manufactured in San Francisco by the Pacific Arc Light Company, in which Mr. Robert B. Elder is largely interested. The lamps now being made are of about 750 candle power, 20 inches in length, weigh seven pounds, use a 5-16 carbon, and are adaptable to either a 110-volt or a 120-volt direct-current. Mr. S. F. B. Morse has taken the Chicago agency, and a New York agency will soon be established.

COMPARATIVE TELEPHONE STATISTICS.—Mr. Louis Glass, assistant general manager of the Sunset Telephone & Telegraph Company, and also of the Pacific Telephone Company, has returned from a tour of the principal Eastern cities. He found that comparisons of telephone facilities are about as follows: Chicago, 14,000 'phones; St. Louis, 7000; San Francisco, 10,000, with prospects of 11,000 by January 1 next. Ninety per cent. of the San Francisco instruments are long distance.

POWER TRANSMISSION.—The San Gabriel Electric Company has opened the bids for its electric-power transmission system, which is to supply Los Angeles, Cal., by February 1, 1898. The specifications call for a generating plant having a capacity of 1200 kilowatts in four units. The voltage on the transmission line will be about 16,000. Three rotary transformers will be used in Los Angeles. For the three-wire conduit distribution 220-volt current will be supplied. Also 500-volt current for street railway purposes and a 2400-volt current for use outside the underground-conduit area. The distance of transmission is 23 miles.

CANADIAN NOTES.

MONTREAL, Que., Oct. 16, 1897.

THE LANARK RATEPAYERS recently expressed themselves at a public meeting as strongly in favor of the Lanark County Electric Railway.

MAGOG, QUE.—A special committee of the Town Council has reported in favor of borrowing $10,000 to purchase an electric-light plant and develop water power.

MESSRS. AHEARN & SOPER, Ottawa, Ont., will build the telegraph line on the Ottawa and New York Railway from Ottawa to Moira, N. Y. It will include a cable across the St. Lawrence River.

THE LONDON STREET RAILWAY COMPANY and the London Township Council have come to terms, and the street railway extension to Pottersburg is to proceed at once.

THE DIRECTORS of the Halifax Street Railway, Halifax, N. S., have decided to issue an additional $200,000 to the stock. This will make the capital of the company $800,000. The new stock will be issued to shareholders on record in proportion of one share to every four held. A quarterly dividend of 1¼ per cent. was paid October 1.

OTTAWA, Ont., October 18, 1897.

A SEMI-ANNUAL DIVIDEND of 4 per cent. has been declared by the directors of the Montreal Electric Street Railway Company, and in addition a bonus of 1 per cent. was given. The earnings of the company, over and above all dividends, bonuses, expense of operations, etc., last year amounted to $102,106.79. It is expected that th e company will transfer to the surplus account this year a sum which will exceed this considerably.

THE TORONTO MAGNETIC OBSERVATORY DISABLED.—During the recent meeting of the British Association, in Toronto, it transpired that the usefulness of the Government magnetic observatory, in that city, had been destroyed by the operation of the electric railway service. The attention of the Dominion authorities was drawn to the fact, and a report on a new location for the observatory has been ordered. In all probability the site will be selected here and the observatory removed to Ottawa, which is free from all the objections which exist in Toronto.

AN EXTENSIVE SYSTEM of electric railway from Montreal through the Eastern townships is being projected. It will be known as the Montreal Southern Counties Railway. It is the intention of the promoters of the enterprise to run a line through Chambly, where it will get the necessary motive power from the rapids. The proposed route embraces St. Johns, St. Alexandre, Bedford, East Stanbridge, Dunham, Cowansville, Sweetsburg, Knowlton, Bolton, Eastman, Magog; thence over Hatley Mountain to North Hatley and Sherbrooke, via Capleton and Lennoxville.

ELECTRIC RAILWAY TOO HEAVILY BURDENED.—The City of Hamilton made a contract with its electric street railway company in 1892, by the terms of which, in addition to a high mileage rate, it agreed to pay a percentage on gross receipts, increasing from 6 per cent. upward. The bargain was a good one for the city, but not so good for the company, and now the latter is threatened with bankruptcy unless the terms are altered. It has petitioned the city for better terms, and unless the request is granted the owners of the electric railway will lose every cent invested in the enterprise.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, September 29, 1897.

HERMITE ELECTROLYTIC SEWAGE PROCESS.—The Hermite process of more or less deodorizing and disinfecting sewage by electricity was announced some little time ago with a great flourish of trumpets, as about to be tried in Bombay. Now, without any flourish of trumpets and without any public notification whatever, the trial has been abandoned, as it is found that notwithstanding that chloride of lime in Bombay costs £14 a ton, the active disinfecting products obtained electrolytically cost about twice as much as those obtained chemically.

ELECTRICAL VEHICLES.—Now that the London Electrical Cab Company has proved so successful, it would seem as if we were on the eve of an electrical vehicle boom. Only last week four companies were registered. One entitled "The Electrical Vehicle Syndicate, Limited," had a capital of £25,000, and the remaining three each had the magnificent capital of £100 in £1 shares, and were entitled respectively "The London Electrical Carriage Company, Limited," "The London Electrical Coupé Company, Limited," and "The London Electrical Van Company, Limited."

MUNICIPAL ELECTRIC LIGHTING.—During the present week another English municipality has decided, after a discussion extending over several years, on an electric-lighting scheme. The municipality in question is the

Wimbledon District Council, Wimbledon being a fashionable residential suburb of London. It is stated in the local papers that about 900 public arc lamps will be provided, while private consumers are to be provided with "5000 incandescent globes." I have not yet heard the particulars of this scheme, but the latter proposal would seem to be distinctly dangerous.

A CABLE TO ICELAND.—In reference to the proposed submarine telegraph cable between the north of Scotland and Iceland, it is stated that the Icelandic Parliament has granted the Great Northern Telegraph Company, of Copenhagen, a subsidy of 35,000 kroners for 20 years. The distance from the nearest point of Scotland to the Faröe Islands is about 250 miles, the greatest depth being 254 fathoms, while the bottom is composed of débris of shells and mud. The distance from the Faröe Islands to Iceland is about 350 miles, the depth averaging a little under 300 fathoms, the bottom being there also composed of sand, shells and mud.

THE ELECTRICAL UTILIZATION OF WATER POWER IN INDIA.—For many years past the Madras provincial Government has been engaged in considering an irrigation scheme known as the Periyar scheme. This magnificent and beneficent work has now been completed, and the Madras Government, like the Chicago Drainage Commissioners, is anxious to turn the great water power available to some useful and remunerative account, and advertisements are being put in the various technical papers asking for tenders. Something like 100,000 horse-power, under a head of 900 feet, are available, but as the nearest approach to a manufacturing centre is the city of Trichinopoly, which is over 100 miles distant from the falls as the crow flies, it will be interesting to observe what will be done.

THE COST OF ELECTRICAL PLANT.—The Islington Vestry, which has already expended about £150,000 upon electric lighting, and contemplates a further expenditure of £40,000, has recently been called upon by the London County Council to look more closely to the estimates of its electrical engineer, as the advisers of the County Council are of opinion that "the work might have been effectively carried out at a less cost." Naturally, this action of the London County Council has resulted in a lengthy report on the whole subject from the electrical engineer to the Islington Vestry. He points out that by the end of 1898 the Vestry will have a plant capable of an output of 1160 kw for an expenditure of £190,000, so that the capital cost per kilowatt will amount to £163, or only £13 above the average for the rest of the metropolis, and this slight increase is due, the engineer points out, not to extravagance, but to the handsome and economical way in which the vestry has provided for the future in the matter of mains, etc.

CATHODE RAYS AND THE TRANSMUTATION OF THE ELEMENTS.—In a Royal Institution lecture delivered in May last, Prof. J. J. Thomson propounded the theory that under the influence of cathode rays the atoms of elementary substances were decomposed into "corpuscules" or "primordial atoms." It was immediately pointed out that if this were so we had at last arrived at the discovery of the Philosopher's Stone, since the atoms being once disunited we should be able to govern their reunion in such a fashion as to get what elementary substance we pleased. This lecture has been published in the October number of the *Philosophical Magazine*, in a considerably amplified form, and Professor Thomson makes a somewhat discouraging statement with regard to the isolation of his hypothetical corpuscules. He says the quantity obtained by means of dissociation at the cathode is so small as to almost preclude the possibility of any direct chemical investigation of the properties of the substance. Thus a coil kept going uninterruptedly night and day for a year would produce only about one-three-millionth part of a gramme of the corpuscular substance.

THE CITY AUTHORITIES AND THE NATIONAL TELEPHONE COMPANY.—The close alliance between the Post Office and the National Telephone Company has already led to some inconvenient results, and would seem likely to lead to more. For instance, at the last meeting of the municipal authorities for the City of London, it was decided to inform the Postmaster-General, who had asked for permission to pull up the streets for the purpose of running conduits, that the city authorities were perfectly prepared to facilitate these operations for the purposes of telegraphy, but they must decline to give permission to pull up the streets on behalf of the National Telephone Company, unless the company was prepared to pledge itself to give an improved service at a reduced rate. I may say that at the time of the amalgamation of the National Telephone Company and Her Majesty's Post Office, the Post Office pledged itself to assist the National Telephone Company as far as possible, in securing rights of way underground in the cities of the United Kingdom, the Postmaster-General having statutory authority to do very much as he likes in the matter of underground conduits, etc. However, cities suffering from an indifferent high-priced telephone service and the superior tone adopted by the National Telephone Company to all mankind in this part of the world, naturally resent the Postmaster-General exercising, on behalf of a joint-stock venture, the authority conferred upon him by Parliament for the purpose of improving the telegraphic service of the country.

General News.

New Incorporations.

THE CHESTER TELEPHONE COMPANY, Chester, S. C., has been incorporated by A. W. Love, A. M. Aitken and others.

THE STANFORD TELEPHONE COMPANY, Stanford, Ky., has been incorporated by B. L. Johnson, with a capital stock of $6000.

THE SOUTH FORK ELECTRIC LIGHT, HEAT & POWER COMPANY, South Fork, Pa., has been incorporated, with a capital stock of $15,000. State Senator Jacob C. Stineman is the president.

THE WELLINGTON TELEPHONE COMPANY, Wellington, Ohio, has been formed, with a capital stock of $10,000. Those interested are A. R. Warner, Edward L. Barber, James Brailey, Jr., G. B. Warner and others.

THE COMMERCIAL ELECTRIC ARC LAMP COMPANY, New York City, N. Y., has been incorporated with a capital stock of $100,000. The directors are Henry C. Jacobs, Adam E. Schatz and George F. Eschwel.

MAPLEWOOD ELECTRIC LIGHT & POWER COMPANY, Attica, N. Y., has been incorporated with a capital stock of $10,000. The directors are Frederick C. Stevens, Edwin T. Gay, Augustus A. Smith and others.

THE CLEVELAND, MEDINA & SOUTHERN ELECTRIC RAILWAY COMPANY, Cleveland, Ohio, has been incorporated. Those interested are F. C. Goodman, James W. Roof and Joseph H. Storer. Capital stock, $750,000.

THE THIRD-RAIL ELECTRIC RAILWAY APPLIANCE COMPANY, Jersey City, N. J., has been formed with a capital stock of $1,000,000. The incorporators are Postmaster Robert S. Jordan, Charles N. King and Belson R. Vanderhoof.

BALTIMORE, MD.—Baltimore, Halethorpe & St. Denis Railroad Company organized. Capital, $100,000. Incorporators: Isaac H. Francis, Ferdinand Hahn, Carville D. Benson, Room 17, Glenn Building, No. 12 St. Paul Street, Baltimore, Md., and others.

THE MAINTENANCE COMPANY, Newark, N. J., has filed articles of incorporation, with a capital stock of $100,000. The incorporators are Joseph M. Cooper, Orange, N. J.; Louis Heck, Newark, and James J. McKenna and Ernest R. Bartlett, New York City.

THE HARRIS BURGLAR & FIRE PATROL TELEGRAPH COMPANY, Detroit, Mich., has filed articles of incorporation. The incorporators are George Harris, William Richter and Charles D. Aaron. The capital stock of the new company is $50,000.

THE NORTHAMPTON & AMHERST STREET RAILWAY COMPANY, Northampton, Mass., has been incorporated with a capital stock of $150,000. The directors are B. E. Cook, Jr., H. L. Williams and L. S. Davis, W. Dwight Cowles, of Amherst, and others.

JUDSON A. GOODRICH COMPANY, New York City, N. Y., has been formed for the purpose of dealing in electrical apparatus. The directors are Charles L. Krekel, Brooklyn, N. Y.; Judson A. Goodrich and R. Ward Hillman, New York City. Capital stock, $10,000.

THE KNOXVILLE, TROUPSBURG & JASPER RAILROAD COMPANY, Knoxville, Pa., has been organized. The promoters are A. Dearborn, Knoxville, president; A. W. Lugg, G. W. Fisk, G. A. Ashton, A. E. Edgecomb, Knoxville, and others. Capital stock, $50,000.

THE KURTZ NATIONAL TELEPHONE COMPANY, Indianapolis, Ind., has been incorporated. The object of the company is to build county-seat plants and to connect them up. The promoters are John N. Cobb, J. V. Mitchell, D. E. Watson, W. J. Kurtz and W. H. Dye.

THE HARRIS ELECTRIC MOTOR COMPANY, Albany, N. Y., has been organized to manufacture electric motors. The incorporators are Jesse Harris, Lynn, Mass.; William D. Harris and Howard Hendrickson, Albany, N. Y. The capital stock of the new company is $2000.

THE NEW ROCHELLE ELECTRIC RAILWAY COMPANY, New Rochelle, N. Y., has been organized to build and operate a road 8 miles long in Westchester County. The directors are William T. Emmett, Charles Nutt, A. E. Walradt, W. H. Neilson, New Rochelle, and others. Capital stock, $80,000.

THE ALPHA COMBINED HEATING & LIGHTING COMPANY, New York City, N. Y., has been incorporated to manufacture devices for heating and lighting. The directors are Asael Wells, William Murray, Isaac Mailhouse, Henry Lewis Jeffries and Loren S. Wells. The capital stock of the company is $60,000.

THE NEW ENGLAND TEMPERATURE CONTROLLING COMPANY, East Orange, N. J., has been incorporated to manufacture electrical devices. The incorporators are William B. Wadsworth, Plainfield; Harry H. Picking, East Orange, and Alfred Luttman, Newark. The capital stock of the new company is $50,000.

THE COLUMBIA ELECTRIC LIGHT & GAS COMPANY, Portsmouth, Va., has been incorporated to manufacture and sell electricity and gas to public and private corporations. The incorporators are Charles Adamson, Griffin C. Callahan, Frank McCafferty, William E. Stokes and J. Walter White.

THE NORTHERN OHIO TELEPHONE COMPANY has been incorporated at Ashland, Ohio, with a capital stock of $10,000. Thomas Brown, of Savannah, has been elected president. The termini of the line will be Ashland and Cleveland, and exchanges will also be put in at Norwalk, New London, Elyria and Wellington.

The Telegraph and Telephone.

CHIPPEWA FALLS, WIS.—The Common Council has granted a franchise for a new telephone system in this city.

HASTINGS, MICH.—A franchise has been granted to the new State Telephone Company to carry on a telephone business in this city.

DALLAS, TEXAS.—The Southwestern Telegraph & Telephone Company has completed its new long-distance line from Galveston to Dallas.

ZANESVILLE, OHIO.—The Newark Telephone Company has completed its lines to thirty towns in Licking County. The system comprises 170 miles of toll lines.

MONMOUTH, ILL.—The Henderson County Telephone Company has completed its line to this place. The system now reaches Smithshire, Roseville, Kirkwood and Monmouth.

IONIA, MICH.—The new State Telephone Company has asked for a thirty-year franchise in this city. It proposes to charge $24 per year for business houses and $18 for residences.

ROCHESTER, N. Y.—A new telephone line will be built from Eyota to

Plainview by way of Potsdam and Elgin. The line between Potsdam and Elgin will be put up this fall and the rest of the system in the spring.

ROCKFORD, ILL.—The Central Union Telephone Company is making arrangements to string a third long-distance copper wire from this place to Chicago in order to accommodate the rapidly increasing business.

CHARLOTTESVILLE, VA.—The Albemarle Telephone Company has begun the construction of its 300-wire metallic circuit exchange in this place. The company expects to have the exchange in operation in thirty days.

DES MOINES, IA.—The business men of Des Moines some months ago joined hands for the purpose of putting in a mutual telephone system. Their plans have been carried out and the new system is now in operation with 1000 telephones on its lines.

ADRIAN, MICH.—The new Adrian Telephone Company has declared a quarterly dividend of 3 per cent. It scored a point against the Bell Company recently when the School Board voted to replace all the Bell instruments in school buildings with those of the independent company.

DES MOINES, IOWA.—The Mutual Telephone Company, which is now building a telephone system here, has 350 telephones in operation. The old exchange has made a considerable cut in rates because of the opposition, but the people appreciate the cause of the cut and favor the Mutual Company.

ANDERSON, IND.—The National Union Telephone Company has been granted a franchise in this city. The company agrees to furnish free to the city all the telephones it needs at the city offices and to give 5 per cent. of the gross earnings to the city each year after 1899. The company expects to have the plant in operation by February 1, next year. Mr. P. G. McDonald, of Indianapolis, is the promoter of the new company.

WASHINGTON C. H., OHIO.—The Citizens' Telephone Company has about completed its system in this city and has put in over 100 'phones. The company has already 200 subscribers on its list. It charges $12 per year for residence instruments and $24 for business houses. The Bell Company, which has operated here for many years, has 160 subscribers, its rates being $16 to $24 for residences, and $24 to $36 for business houses.

MEMPHIS, TENN.—The opposition of an independent telephone company in Columbia, Tenn., has brought down the rates charged by the Bell Telephone Company for residences to 50 cents per month. The citizens of Nashville have made a demand that the rates in Nashville be placed at the same figure, and base their demand on a section of the Tennessee State laws, which states that "every telephone company doing business within this State and engaged in a general telephone business, shall supply all applicants for telephone connections and facilities without discrimination or partiality."

CLEVELAND, OHIO.—At a recent meeting of the Board of Control, an application from the Cleveland Telephone Company to build subways in East Madison Street was laid over for the present. The mayor said that it was time for the city to control any new subway construction. There is some talk of obtaining the authority of the Legislature to undertake the work. The General Assembly will have to confer with the Board upon the issue of bonds for that purpose. The total length of underground wire used for electrical purposes at the present time is 10,151 miles, and within five years between 30 and 40 miles of subways have been constructed.

ELECTRIC LIGHT AND POWER.

CONNELLSVILLE, PA.—The Dunbar Furnace Company proposes to erect an electric plant.

BRIGHTON, MICH.—The city is agitating the question of erecting an electric-lighting plant.

PITTSFIELD, ME.—The city is considering the question of erecting its own electric-light plant.

CANAL JUNCTION, OHIO.—The Council proposes to erect a municipal electric-lighting plant.

WAUKEGAN, ILL.—The citizens have under consideration the establishment of a municipal lighting plant.

PEORIA, ILL.—The Peoria & Pekin Union Railway Company will erect a new electric-lighting plant at this place.

PADUCAH, KY.—The Paducah gas works were leased to A. C. Einstein. The gas and electrical plants will be enlarged.

MILAN, MO.—The citizens on October 5 voted to issue bonds in the sum of $18,000 for the construction of a light and water plant.

READFIELD, ME.—A company is being formed for the purpose of building an electric plant to supply light to Winthrop, Hunt's Hill and Readfield, Me.

PORTLAND, ME.—The Portland Electric Light Company has petitioned the Board of Aldermen for permission to build an electric line through the city.

WOODBURY, CONN.—The citizens of this place are discussing the question of building an electric-light plant for the purpose of street and private lighting.

DUNDEE, N. Y.—Mr. E. L. Bailey, of Penn Yan, has made a canvass of this place, with a view of lighting the town with electricity. He will probably be granted a franchise.

SALEM, N. Y.—The Board of Trustees are agitating the question of lighting the streets by electricity. A meeting of the taxpayers will be called to vote upon the question.

MILAN, MO.—A special election was held here on October 5, and the proposition to bond the city for an electric-light plant and water works was carried by a large majority.

WILKINSBURG, PA.—The Rural Electric Light Company has petitioned the Council for a franchise. The new company intends to begin the erection of a plant within a short time.

LACONIA, N. H.—The Laconia Electric Lighting Company has been granted a franchise to extend its wires to the water power in East Tilton and add to its business in any other direction.

PRINCETON, MINN.—The Princeton Roller Mill is to increase the power and has made the city an offer to put in an electric-lighting plant for public use when it makes its mechanical change.

PINE BLUFF, ARK.—A company has been formed for the purpose of erecting an electric-lighting plant and constructing an electric road at this place. The Council has been petitioned for a franchise.

CHICAGO, ILL.—The Cicero Water, Gas & Electric Light Company has offered to sell its Oak Park plant to the township of Cicero for the sum of $1,820,000, to be paid in twenty-six annual installments.

WARWICK, N. Y.—Mr. J. H. Sharpe, general manager of the electric light company at Liberty, will establish an electric-light plant in this place if sufficient support will be accorded the enterprise.

COFFEYVILLE, KAN.—An election will probably be held shortly to vote on the question of issuing $17,000 worth of bonds for the erection of a municipal electric-lighting plant. Address the mayor for further information.

WHITESTONE, L. I., N. Y.—The Board of Trustees has called a special election for October 29, when the question of deciding upon a system of public illumination will be voted on. They are in favor of electric lighting.

SCRANTON, PA.—An electric locomotive in a coal mine here saved $2528 in 200 days by its replacement of steam power. An electric pump in the same mine is said to have saved $1500 in three years' time over steam pumps.

GOLDSBORO, TENN.—The electric-light company here is about to install two larger dynamos, as those now in use are loaded to their full capacity. The company is not able, at the present time, to meet the demand for light.

CHARLOTTESVILLE, VA.—The electric-light company of this city has offered to furnish the city with arc lights at the same cost as gas, but the city authorities would not accept the offer. The gas plant is owned by the city.

PLYMOUTH, PA.—Petitions are being circulated requesting the Council to pass an ordinance allowing the voters to decide at the next municipal election whether or not the borough shall be bonded for $12,000 to purchase an electric plant.

ANDERSON, IND.—The plant of the Anderson Electric Light & Power Company has been purchased by the city, and the property will be operated under municipal control. The price paid for the plant is stated to have been $34,000.

ORTONVILLE, MINN.—Bids will be received November 2 for the construction of a water and light plant. Plans are on file in the office of the engineer, C. F. Loweth, 94 East Fourth Street, St. Paul, and at the office of the recorder, S. A. Thomas.

CUMBERLAND, MD.—The City Council has accepted the plans for a municipal electric plant prepared by the F. B. Rae Engineering Company, and the city clerk has been instructed to advertise for bids to furnish the apparatus, machinery and labor required.

MANCHESTER, N. H.—The question of street lighting is being discussed, and bids will probably be asked for. Councilman Gunderman thinks that the only way to save money on lights is to have the Legislature authorize the city to issue bonds to build its own plant.

McMINNVILLE, TENN.—The electric-light plant in this place, which was operated by a private company, has been purchased by the town authorities. The purchase price was $2500, but this does not include the power. The entire plant will be repaired and enlarged.

ROMEO, MICH.—The municipal electric-light bonds have been sold to the Romeo Savings Bank, which was the highest bidder of twelve, offering a premium of $752, with accrued interest. The bonds expire in 1914. It is expected that the new plant will be in operation by December 1.

UTICA, N. Y.—Some of the citizens of Camden in this State have under consideration a project of utilizing the water power of Mad River, for the purpose of lighting the village by electricity. It is stated that there is a fall of 63 feet, and water sufficient to develop 200 horse-power.

MILFORD, MASS.—The Milford Heat, Power & Refrigeration Company has accepted the proposition of the Milford Electric Light & Power Company for the purchase of its plant. The new company, it is stated, will expend about $50,000 in remodeling the station and extending the service.

OCALA, FLA.—An ordinance has been referred to the Judiciary Committee, authorizing the issuing of bonds for the erection of an electric-light plant, to be owned and operated by the city. The ordinance provides for a special election to be held for the purpose of voting on the motion.

GOSHEN, IND.—Preliminary steps are being taken for the extension of the city electric-light plant, and it is expected that $10,000 will be expended in this direction. The city for a long time has been poorly lighted. The improvements will include a new engine and a dynamo of a capacity of 150 arc lights.

COLUMBUS, OHIO.—It is reported that there is a movement on foot among certain capitalists in this city and New York to get control of the Columbus Electric Light & Power Company's plant and equip it with modern machinery for the generation of electricity and operate it on a much larger scale than heretofore.

SELLERSVILLE, PA.—A movement is on foot to erect a plant for the purpose of furnishing electric light to Sellersville and Perkasie. It is proposed to build a power station midway between the two places. Philadelphia capitalists are back of the enterprise. The Sellersville Council is considering an ordinance granting the franchise.

LOUISVILLE, KY.—The Board of Public Works has let the contract for public lighting by electricity to the Louisville Electric Light Company, for a period of five years. The price is the same as it has been for the past five years, namely, $84 per year per lamp. There are now 1225 lamps in use, and the number is being constantly added to.

COLUMBUS, OHIO.—The Director of Public Improvements has practically

completed his report on the cost of erecting and equipping an electric-light plant to be operated by the City of Columbus. It is stated that the report will recommend the erection of such a plant, and it will show that arc lights may be supplied by the city for lighting for less than $40 each a year; in fact, for $32.50.

The Electric Railway.

BIRMINGHAM, ALA.—The Birmingham Traction Company contemplates changing its motive power to electricity.

CHICAGO, ILL.—The City Railway Company has decided to change the motive power on its trunk lines from cable to electricity.

MIDDLETOWN, MD.—The directors of the Frederick & Middletown Electric Railroad have decided to build a power house in Middletown.

MILFORD, CONN.—It is stated that the Milford Street Railway Company has secured its right of way, and will soon let contracts to build.

HANOVER, MASS.—The directors of the Hanover Street Railway Company have voted to extend the street railway from Assinippi to Norwell Centre.

GRANVILLE, N. Y.—It is proposed to build an electric railroad between this place and Whitehall. Joseph Powers, of Lansingburgh, N. Y., is interested.

FITCHBURG, MASS.—An electric railroad will be built between this city and Westminster. Mr. S. D. Simonds, of Westminster, is interested in the project.

HELLERTOWN, PA.—The South Bethlehem & Hellertown Street Railway Company has petitioned the Town Council for permission to erect an electric road here.

BRIDGEPORT, CONN.—A meeting of directors of the Bridgeport Traction Company is to be held to pass on the question of the extension from Southport to Westport.

LITTLE FALLS, N. Y.—An electric railroad is to be built from Herkimer to Little Falls. The Common Council of Little Falls has granted a franchise to build the road through the town.

WASHINGTON, D. C.—The Capital Railway Company has begun the survey of a route for an overhead trolley electric line between Washington and Chesapeake Beach, a distance of about 25 miles.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company has had introduced into the Council an ordinance to give Frederick Pabst the right to lay electric and steam conduits in certain streets on the East Side.

WAYNESBORO, PA.—The Supervisors for Washington Township granted a franchise to the Blue Ridge Electric Railway & Power Company for the proposed Blue Ridge trolley line along the township road from Monterey to Blue Ridge Summit.

NORTH BROOKFIELD, MASS.—The matter of an electric railway from this place to East Brookfield is again being agitated, the directors of the Warren, Brookfield & Spencer Street Railway Company having asked for a franchise to East Brookfield.

SOUTH BETHLEHEM, PA.—The Easton & Bethlehem Electric Railway Company is considering the advisability of using water power with which to generate electric power for the operation of the road. The water power will be obtained from the Lehigh River.

POTTSTOWN, PA.—Negotiations are in progress between the Schuylkill Valley Traction Company and the Pottstown Passenger Railway Company in relation to extending the line of the Traction Company from Prappe to Sanatoga, there to unite with the Passengers' Company's line.

JOLIET, ILL.—The Kankakee, Wilmington & Morris Electric Railway Company has been granted a fifty-year franchise to run its line through the southern part of Will County. The proposed line, which is to carry freight as well as passengers, will tap the larger part of the coal fields of the Wilmington district.

PENN YAN, N. Y.—The Penn Yan & Pennsylvania Railroad Company, incorporated. Capital, $400,000. To build an electric railroad to Savona, Steuben County, connecting with Rochester Division of the Erie Railroad, to Penn Yan, etc. Directors: George F. Andrews, of Owego; James Roberts, Binghamton, and others.

CLEVELAND, OHIO.—In the street railway-fare matter the mayor has offered a compromise to the street railway company. He agrees to accept 5-cent fares, with six tickets for a quarter, and a tax of 5 per cent. on the gross receipts in return for an extension of franchise to 1914, when the old franchise now in force expires.

McKEESPORT, PA.—A charter has been issued to the East End Passenger Railway of this city to build an electric road from the line of the city to the Driving Park in Versailles Township. John K. Skelley is president. Directors are W. E. Hartman, John R. Christy and R. C. Rankin, of this city, and William Beal, of Pittsburg.

COLUMBUS, OHIO.—The Columbus Street Railway Company and the Columbus Central Railway Company have virtually agreed to consolidate, a conference with that purpose in view having been agreed upon. It is understood that the Columbus is to pay $3,000,000 for the Central property and assume the latter's indebtedness.

KALAMAZOO, MICH.—H. P. Kauffer, E. S. Ross, W. G. Howard and H. C. Reed, of this city, have sold their interests in the Battle Creek Electric Railway to New York capitalists. This means the consolidation of the Kalamazoo and Battle Creek Railways, and the construction of the electric line between these cities. The new line will cost $30,000.

GEORGETOWN, N. Y.—At a recent meeting of a large number of Binghamton business men to discuss the feasibility of constructing an electric road from Georgetown to that city, the fact was demonstrated that people all along the line are ready to give the enterprise financial assistance as soon as they are sure that the parties who are back of the project mean business.

Legal Notes.

CARPENTER PATENTS ON ENAMEL RHEOSTATS.—Judge Kirkpatrick, upon September 11 last, handed down a decision in the suit of the Carpenter-Nevins Electro Heating Company *v.* H. Ward Leonard et al., in favor of the defendants, H. Ward Leonard and others. This decision marks the termination of the controversy over the patents on enamel rheostats issued to Charles E. Carpenter. Shortly after Mr. Carpenter invented the enamel rheostat he sold his patents on this subject to the Carpenter Enamel Rheostat Company, who, in turn, sold them to H. Ward Leonard. After many years and a great deal of money having been spent in perfecting the enamel rheostat, the Carpenter-Nevins Electro Heating Company, of Minnesota, which had owned certain patents of Mr. Carpenter for electric heaters, and had ceased doing business, fell into the control of the American Electric Heating Corporation, of Boston. Suit was then instituted against Mr. Leonard, Mr. Carpenter and the Carpenter Enamel Rheostat Company, alleging that enamel rheostats were electric heaters, and claiming title on this ground, to a large number of Mr. Carpenter's patents, which Mr. Leonard has bought. After continuing the contest for several years, the American Company abandoned the suit, and Judge Kirkpatrick's decision was one dismissing the suit for lack of prosecution. This decision, it is stated, establishes a clear title for Mr. Leonard to the Carpenter enamel rheostat patents.

Personal Notes.

MR. CHARLES B. STERLING, of C. B. Sterling & Co., New York, was married a few days ago to Miss Julia Lindsey Morris, of Perth Amboy, N. J. The ceremony took place in New York City.

MR. JAMES MARK BARR, formerly connected with the Westinghouse Electric & Manufacturing Company, was married on October 6 last, to Miss Mabel Richie, at Littlecote, Pinner, England.

MR. GEORGE E. PRATT, late secretary and general manager of the Hunt Air Brake Company, Pittsburg, Pa., has severed his connection with that concern and entered the service of the Standard Air Brake Company, of New York, as special agent.

Obituary Note.

COL. WILLIAM H. FORBES, who was at one time president of the American Bell Telephone Company, died at his summer home on Naushon Island, Buzzard's Bay, Mass., on October 11, at the age of fifty-five years.

Trade and Industrial Notes.

AN ILLUSTRATED CATALOGUE, descriptive of the miniature decorative incandescent lamps manufactured by Messrs. E. B. Latham & Co., 136 Liberty Street, New York, has just been issued by that firm. A copy of the catalogue may be had on application.

A CORRECTION.—The Buckeye Electric Repair Works, Columbus, Ohio, have called our attention to an error which inadvertently crept into their advertisement in the last issue of The Electrical World. The location of the works was erroneously stated as Cleveland, Ohio. It should have been Columbus, Ohio.

A BATTERY TABLE LAMP has just been brought out and put upon the market by the Ohio Electric Works, Cleveland, Ohio. The Ohio Electric Works anticipates a large sale for this light, and is ready to give the exclusive agencies to early applicants. The company's new catalogue for 1898 is now ready for distribution.

AN AGENCY has been established in Cleveland, Ohio, by Mr. A. O. Schoonmaker, 158 William Street, New York City, dealer in India and amber mica. Messrs. Hayes & Arthur, Cuyahoga Building, Cleveland, Ohio, have been appointed the agents for Cleveland and vicinity. They will carry in stock a full line of mica ready for immediate shipment.

ELECTRIC HEATING.—In the article describing the Lachine Rapids power-transmission plant, which was published in The Electrical World of October 2, the work of installing the electric heating apparatus was erroneously credited to the Canadian General Electric Company. Credit for this work is due to the Dominion Electric Heating Company, of Ottowa, Ont., which furnished the apparatus.

A HANDSOMELY ILLUSTRATED BULLETIN has just been issued by the Keystone Electric Company, Erie, Pa., descriptive of its Class C direct-current multipolar generators and motors for light and power. These machines, complte, and the various component parts, are artistically illustrated and their construction fully described. Detailed dimensions of the various machines are given in tabular form, this being followed by plan and elevation diagrams of the machines, and diagrams showing the windings and connections.

IVORY NAME PLATES.—The Endolithic Ivory Company, of London, has appointed the Western Electric Company, of Chicago and New York, as agent for its goods in the United States. This company manufactures all kinds of name plates for dynamos, testing instruments, switchboards, furniture; in fact, for anything where a name plate may be used. The Western Electric Company is using these name plates on its desk fans. These plates are either of bone or ivory, with the name engraved upon the material and colored by a special process.

THE AYERS SELF-LOCKING ARC LAMP WINDLASS is not a new article, and is reasonably well known to the trade, but it has not hitherto received the attention which it deserves. The Electric Appliance Company, Chicago, has, however, recently taken up this article as a leader. The Ayers windlass is probably the simplest and most durable windlass ever constructed,

being built to stand the wear and tear of rough work. It is claimed by many that the only safe method of suspending lamps is the windlass arrangement, which is a little more expensive to install, but is the cheapest in the long run.

MULTIPOLAR MOTORS seem to be in extraordinary demand this fall. Since the introduction of the C & C enclosed ironclad multipolar motor a few months ago, the C & C Electric Company, New York City, reports that it has been fairly swamped with orders for this machine. It is producing them in all sizes, from 5 to 40 horse-power, and they are so arranged that they may be placed in any desired position and back geared, or directly connected to the work. During the last week orders for this class of machine have been unusually numerous. The C & C Company seems to be particularly busy this fall in all departments.

THE RIES REGULATING SOCKET for alternating current is being handled by the McCay-Howard Engineering Company, 106 East German Street, Baltimore, Md. This company states that it is meeting with great success with these devices, and has put out a large number of them. These sockets are now applied to small alternating current fan motors, and it is stated that they govern these machines much more perfectly than has hitherto been possible by any other means. It is stated that one large manufacturing concern has equipped all of its fan motors with this regulating socket, as it can be applied with greater ease and at less cost, and give far better regulation than special winding.

THE STORAGE BATTERY PLANT of seventy-one cells of storage battery installed in the Criminal Court Building, Centre Street, New York, by the Electric Storage Battery Company is now ready for use, and is awaiting the completion of the building's generating plant. Each cell has a capacity of 2200-ampere hours. The dimensions of the cell are 26 inches wide, 22 inches long, and 24 inches high, and the elements consist of 27 plates, 15½ by 15½ inches in size. This plant was installed by Messrs. Buchanan & Co., of Philadelphia, who had the bulk contract.

THE STIRLING METAL COMPANY is the name of a new company which has just begun the manufacture of anti-friction metal, also various grades of Babbitt metal and white brass, at Stirling, N. J. Mr. J. Gray Torrey is the general manager, and Dr. Herbert G. Torrey, who, for the last eight years has been connected with the Magnolia Anti-Friction Metal Company, is the consulting expert of the new company, which will make special grades of anti-friction metals to meet particular requirements or duplicate samples submitted by customers. The sales office of the Stirling Company is at 102 and 104 Fulton Street, New York City, and is in charge of Mr. William A. Locke, sales manager.

AMERICAN ENGINES IN JAPAN.—A letter to the Phoenix Iron Works Company, Meadville, Pa., from Mr. S. D. Niwa, consulting engineer of the Yokkaichi Electric Light Company, Yokkaichi, Japan, speaks in the highest praise of the Dick & Church compound engine, which was installed in the station of that company. Mr. Niwa states that he has never seen such a good high-speed compound engine, and that when the engine is running no other noise than that made by the belt is noticeable, the engine itself working practically noiselessly. The Yokkaichi Electric Light station was opened on September 1, and already its total output has been reached. It is likely that an additional engine and dynamo will be installed.

THE FERRACUTE MACHINE COMPANY, Bridgeton, N. J., has been very busy for many months past, and has received a large number of orders from various electrical factories. It has recently furnished four of its large double-crank presses to the Westinghouse Company, Pittsburg, Pa., of the same style as those furnished to the General Electric Company some time ago. The company is also furnishing to various firms throughout the country a number of its special presses with indexing attachment for notching armature discs, and several of them are going abroad. It also manufactures various other sizes and styles of electrical presses for general electrical work. The company's shops have been recently enlarged, and some new machinery added.

THE WEBSTER SYSTEM OF STEAM HEATING will be installed by Messrs. Warren Webster & Co., Camden, N. J., in the plants named below: Vermont State Prison, Windsor, Vt.; Sun Life Building, Crescent Bath Building, and Pope Manufacturing Company, Louisville, Ky.; Western Kentucky Asylum for the Insane, Hopkinsville, Ky.; Lambertville Rubber Company, Lambertville, N. J.; Heywood Brothers & Wakefield Company, Chicago, Ill.; Connell office building, Scranton, Pa.; Mende Brothers' factory, Philadelphia, Pa.; Parkside apartment house, Philadelphia, Pa.; Grosvenor Dale Company, Mill No. 1, Grosvenor Dale, Conn.; Myron F. Thomas shoe factory, Campello, Mass.; Chadwick Lead Works factory, Forest River, Mass.; Cincinnati Passenger Station, P., C., C. & St. L. Ry. Co., Cincinnati, Ohio.

M. I. C. COMPOUND.—We have received from the Mica Insulator Company, New York and Chicago, a sample card containing a short length of copper ribbon coated with M. I. C. compound. This compound is an enamel, black in color, and manufactured in four grades to suit all possible requirements. Each grade is said to be perfect as an insulator, wet or dry, durable and elastic. It is non-corrosive, stands high temperature, is impervious to moisture, has no offensive odor, has a full body and can be reduced to any density of solution. The compound is intended for insulations and coatings of all parts of motors, generators, armatures, field magnets, wires, cables, transformers, overhead-line construction, arc lamps, switchboards, all bare metal surfaces, etc., and it is recommended to manufacturers of electrical apparatus of all kinds. The composition of this product consists chiefly of refined linseed oil, asphalt and rubber.

THE STANDARD TELEPHONE & ELECTRIC COMPANY, Madison, Wis., has issued a very complete and well illustrated catalogue of its extensive line of manufactures of telephone apparatus. The standard and intercommunicating instruments are shown to good advantage, and the house or hotel 'phone is also represented in such a manner as to give at a glance a good idea of its construction. Compactness seems to be one of the special features of this company's apparatus. The Mildé carbon microphone is used on these instruments. It is also illustrated, and its important features pointed out. The Standard Company makes a large line of specialties, including adjustable switchboard transmitters, linemen's testing sets, standard arresters, etc. The portable instruments are very handsome in appearance, and are well designed for their particular purpose. Various styles and sizes of switchboards are also shown, and, taken altogether, the catalogue may safely be classed as one of the most complete of its kind that has ever been produced.

A VERY COMPLETE CATALOGUE of electrical supplies has just been issued by J. H. Bunnell & Co., 76 Cortlandt Street, New York City. One noteworthy feature of the Bunnell catalogues is that the number of pages is constantly increasing. This latest production is very completely illustrated, and covers every department of electrical trade. The number of accessories employed in the various branches of electrical industry is little appreciated until a look is taken at a catalogue of this character, where all sorts of devices are described and illustrated. Messrs. J. H. Bunnell & Co. carry a full line of apparatus of every description for the telegraph, telephone and for electric lighting, electric railway and electric bell work; also electric-lighting fixtures, plating machines, etc., etc. The new catalogue contains 224 pages inside of the cover, on the front page of which is given a fac-simile of the award received by the firm at the World's Fair. In addition to the general catalogue this firm issues special catalogues of miniature and decorative incandescent lamps, open and long-burning arc lamps for both direct and alternating circuits, phonographs, etc.

THE TRANS-MISSISSIPPI & INTERNATIONAL EXPOSITION, which will be held at Omaha, Neb., from June to November, 1898, will contain an electrical exhibit with many interesting features. Mr. Luther Stieringer has been engaged as consulting electrical engineer for the exposition. The illumination features will reveal some handsome effects arranged by Mr. Stieringer, among which will be an "electrical garden," showing the various hues and tints of the flowers by means of colored screens and powerful searchlights. Electricity in agricultural work will also form one of the special features, and recent applications of electricity in long-distance transmission of power and its distribution, electricity in mining, electro-metallurgical processes, long-distance telephony, electric cooking, etc., will be prominently exemplified. Applications for space have been made by the following named concerns: The Walker Company, Fort Wayne Electric Corporation, General Electric Company, Western Electric Company, Wagner Electric & Manufacturing Company, Crocker-Wheeler Electric Company, the Okonite Company, the Cutter Electrical & Manufacturing Company, the Keystone Electrical Instrument Company, the Cutler-Hammer Manufacturing Company, and E. G. Willyoung & Co. It is the desire of the officials of the exposition to bring together on this occasion an electrical exhibit that will be the finest demonstration of the kind ever assembled.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

LETTERS FROM FARMERS in South and North Dakota, relating their own personal experience in those States, have been published in pamphlet form by the Chicago, Milwaukee & St. Paul Railway, and as these letters are extremely interesting, and the pamphlet is finely illustrated, one copy will be sent to any address on receipt of 2-cent postage stamp. Apply to E. F. Richardson, General Agent Passenger Department, 381 Broadway, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 12, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

591,376. SIGNALING ON RAILWAYS; A. C. T. Bond, London, England. App. filed May 14, 1897. A railway signal, comprising two rails and a return, batteries connected respectively with the rails and the return, contacts for rendering either of the batteries inoperative and a lever between the contacts for operating them, together with a cap electrically connected with the rails and the return, and carrying signal devices in the electrical connections.

591,425. ELECTRICAL PROTECTOR; C. A. Rolfe, Chicago, Ill. App. filed Jan. 11, 1897. A protector, comprising a cut-out for removing the instrument from the line, a ground circuit provided with a cut-out operating upon an excess of current therein, and means for including the ground cut-out in the ground circuit after the operation of the line cut-out.

591,442. BINNACLE; F. M. Wherren, South Elliot, Maine. App. filed July 2, 1896. In a binnacle, the combination of a case, a compass inclosed therein and a lamp, of a light-conveying tube, whereby light is conducted from said lamp and delivered upon the face of said compass, an inner removable tube held in said light-conveying tube, and a mirror supported by said removable inner tube.

591,451. ELECTRIC SWITCH; J. C. Cassidy, East Orange, N. J. App. filed March 20, 1897. An electric switch and cut-out, consisting of a frame having collars and a screw which are integral parts of said frame, to which

said collar of said frame is affixed an insulating block by means of a screw, said block carrying contact pieces having screws and an arm, in combination with a rotary shaft, said rotary shaft having affixed at one end a finger piece, and bears through an opening in the aforesaid collar, through the rotary wheel and through an insulating wheel and collar into an insulating block, said rotary wheel having a smooth surface and corrugations, and said insulating block having an insulated surface and a conducting surface, all in combination with a spring fastened to said frame by a screw, said spring carrying a roller adapted to engage with the corrugations, all so arranged with reference to each other that the said rotary wheel and insulating wheel will be caused to revolve together when said rotary shaft is caused to revolve, and said corrugations being so placed with reference to said conducting surface that when the spring, by means of the roller, is in engagement with the corrugations, the said conducting surface will be in juxtaposition to the said corrugations, all in combination with the contact pieces and contact screws.

591,486. CARBON HOLDER FOR ARC LIGHTS; O. S. Moss, Syracuse, N. Y. App. filed Jan. 28, 1897. A carbon holder, comprising a top adapted to receive a lamp rod, and having an inner convex-bearing surface, a side piece having both faces concaved, one of which is adapted to engage with the carbon, and the other with the inner face of the top, and means for holding them and the carbon together.

591,489. TROLLEY WHEEL; R. S. McPhail, Toronto, Canada. App. filed May 18, 1896. In combination, with the trolley pole having forked ends, cups immovably secured in said ends, a hollow axle journaled in said cups, oil conduits running obliquely through said ends and cups, and discharging directly into said hollow axle, the filling end of said conduit being located in the outer face of the forked ends, said axle having distributing oil-conveying notches in the body thereof leading from its interior to its exterior, said notches extending full width of the bearing surfaces of said cups.

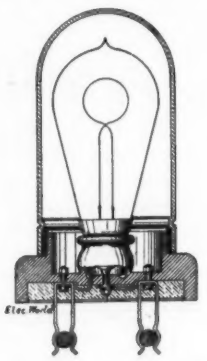
591,490. FITTING FOR GLOW LAMPS; F. Palm, Nuremberg, Germany. App. filed May 10, 1897. A holder for glow lamps, consisting of the insulated socket provided with pressure fingers for each terminal, in combination with the naked main wires properly spaced apart.

591,491. ELECTRIC SWITCH; J. W. Parkin, Philadelphia, Pa. App. filed Jan. 21, 1897. In an electric switch, a disc, a contact strip mounted thereon, one end of which projects through said disc, a plurality of auxiliary contact strips supported on said dics, and each having an end projecting therethrough, a second disc rotatably supported, and a contact plate mounted on said last mentioned disc, which is adapted to contact with said contact strips and close the circuit.

591,499. ELECTRIC DENTAL MALLET; P. Russell, New Market, Md. App. filed Oct. 6, 1896. In an electromagnetic dental mallet or similar tool having a helix surrounding a hollow iron core, the combination of the mallet stem passing axially through said core and consisting of a magnetic part and a non-magnetic part, with the iron core hammer surrounding the non-magnetic part.

591,516. ELECTRICAL RAIL BOND; W. H. Wiggin, Worcester, Mass. App. filed April 26, 1897. An electrical rail bond, composed of a flat-sided plate, provided on one of its side faces at its respective ends with terminal studs adapted to seat in apertures in the web of the meeting ends of rails and having a partial, flatwise twist in its central portion or body, between said terminals.

591,556. MECHANICAL SPLICE EAR; H. H. Luscomb, Hartford, Conn. App. filed July 1, 1897. A splice ear, having means for attachment to a supporting part, a wire groove along the lower edge and opening downwardly, and a movable jaw arranged to project into the wire groove and



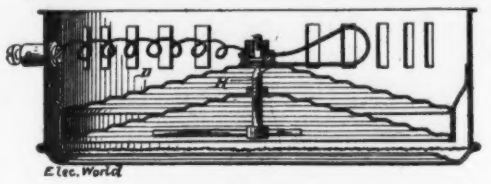
No. 591,490.—Fitting for Glow Lamps.

normally make contact with the surface of the wire in the groove in a manner that allows the wire to be thrust into the groove, but not drawn out of the groove.

591,623. DYNAMO-ELECTRIC MACHINE; E. W. Farnham, Chicago, Ill. App. filed June 14, 1897. In a dynamo, the combination of a frame, an armature rigidly secured in the frame, a cylinder over the armature rotatably mounted on the non-rotatable axle of the armature, magnets secured in the cylinder so that the positive poles thereof are adjacent and the negative poles are adjacent, cheek pieces uniting the positive poles and cheek pieces uniting the negative poles, a commutator ring and collector rings on the armature electrically connected with the wound wire of the armature and brushes rotating with the cylinder secured to such cylinder in electrical contact with the commutator and collector rings.

591,624. TELEGRAPH KEY; E. W. Farnham, Chicago, Ill. App. filed July 19, 1897. In an electric-sending key, the combination of a depressible lever, an auxiliary depressible lever, a spring attached at its ends to the levers, respectively, yieldingly holding them in a raised position, a contact point on the auxiliary lever and a spring anvil in electric connection with one of the main-line binding posts of the sending key, whereby the depression of the first named lever with force the contact point on the auxiliary lever into contact with the spring anvil and close the circuit in which the sending key is placed.

591,625. DYNAMO ELECTRIC MACHINE; E. W. Farnham, Chicago, Ill. App. filed July 19, 1897. In a dynamo, the combination of a permanent C-shaped magnet, a frame in which the magnet is placed, an armature rotatably mounted in the end walls of the frame, a cylinder forming a



No. 591,700.—Thermic Fire Alarm.

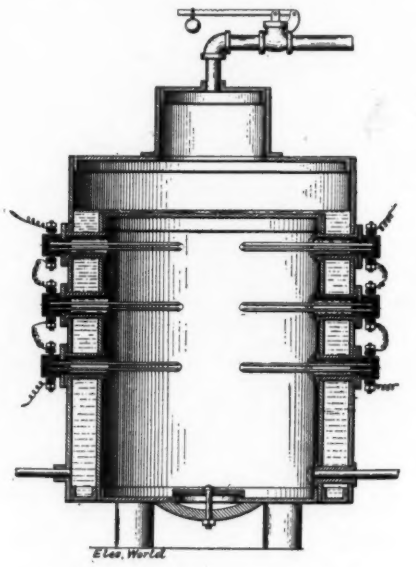
casing to the armature, and an outer casing rotatably mounted on the ends of the frame with the inner peripheral surface of the cylinder forming part of the casing in frictional contact with the cylinder of the armature so that rotation of the outer casing produces rotation of the armature.

591,641. ELECTRIC METER; G. A. Scheeffer, Peoria, Ill. App. filed Dec. 9, 1896. The combination, with circuit terminals, of a fluid-conducting medium connected therewith, a closed chamber or receptacle for said medium, armatures maintained in electrical contact with said conducting medium, and means for directing the greater portion of the current flowing between said terminals through the armatures in series.

591,698. TROLLEY; G. K. Shryock, Johnstown, Pa. App. filed April 23, 1897. A trolley support for the top of a car, consisting of two arched springs arranged longitudinally with the car and having each a pair of rollers at its end, receiving between them the body of the other spring.

591,700. THERMIC FIRE ALARM; K. O. Slosky, Philadelphia, Pa. App. filed June 5, 1897. A thermic fire-alarm, consisting of two concave-convexo discs, having their surfaces corrugated, contact points carried by said discs, and an electric circuit in which the alarm is included.

591,706. ELECTRIC RAILWAY; D. Urquhart and F. Wynne, London, England. App. filed Nov. 17, 1896. In apparatus for supplying electricity to electrically propelled vehicles, the combination, with road contacts, a main conductor, and electromagnetic devices or switches for successively placing said road contacts in connection with said main conductor, of conducting guard plates or rails located in proximity to the road contacts and adapted to be connected to the main conductor by the switch of the cor-



No. 591,783.—Electric Heater.

responding road contact, and to be then placed in parallel with the electromagnetic winding of the said switch.

591,725. PROTECTING-ALARM CIRCUIT: I. E. Barriclow, Dallas, Texas. App. filed June 22, 1896. In a device for protecting electric circuits, the combination of a suitable alarm, an electromagnetic device controlling said alarm and arranged to be held normally inoperative by a current of certain intensity, a circuit including both the alarm-actuating device and the distant objects to be protected, pole changers located in said circuit at the station, and at the distant object, respectively, resistances adjacent to the respective pole changers, and adapted to be alternately introduced into the said circuit, and means for actuating the pole changers synchronously.

591,783. ELECTRIC HEATER; O. D. McClellan, Philadelphia, Pa. App. filed Oct. 17, 1895. A heater, comprising a gas-tight receptacle, carbon points arranged therein, and an inert gas filling said chamber and designed to circulate therein.